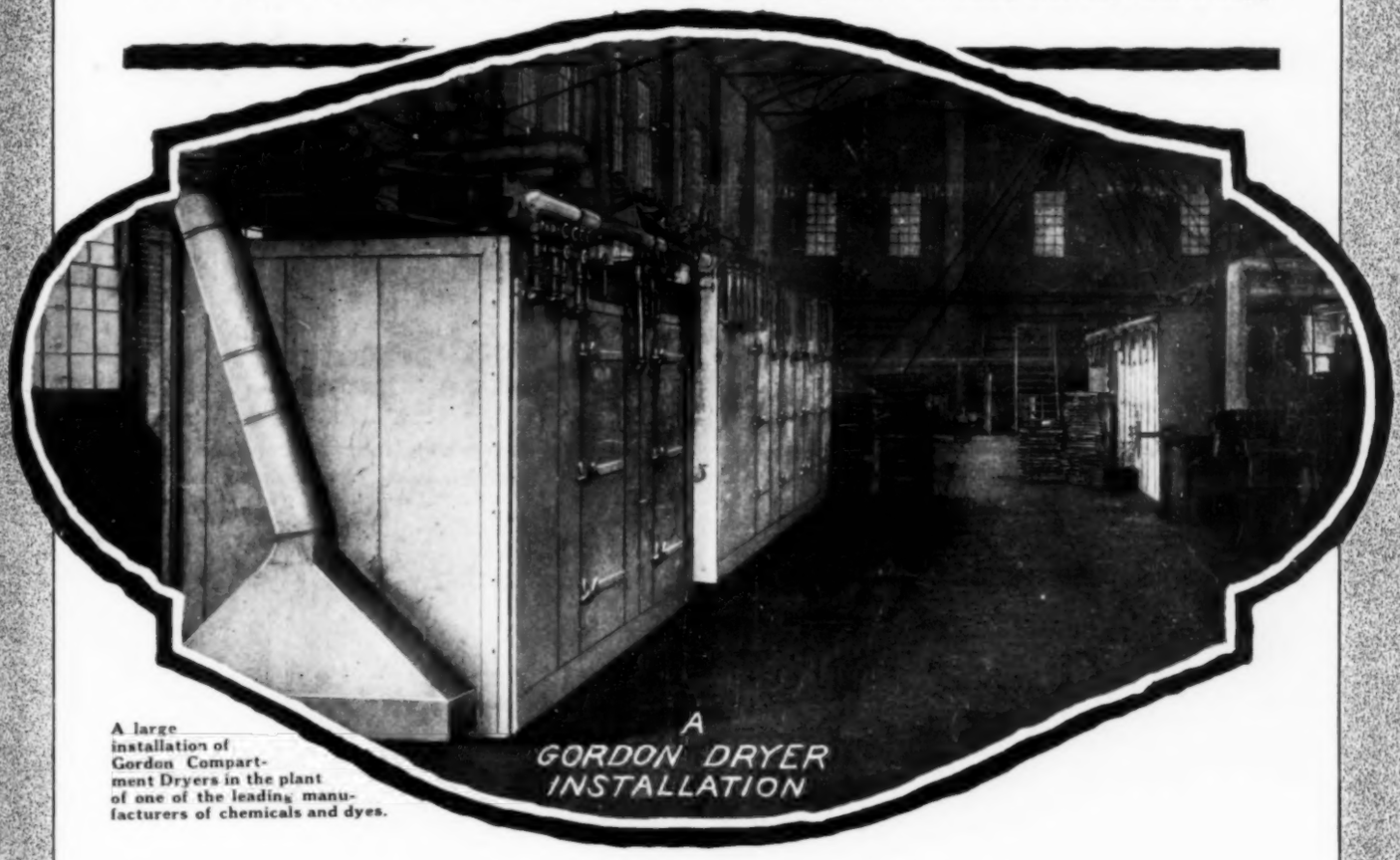
Published December 13 with Current News

CHEMICAL & METALLURGICAL ENGINEERING

New York, N. Y., Nov. 12—19, 1919 McGraw-Hilll Co., Inc. Vol. XXI, No. 12, 25c. a copy



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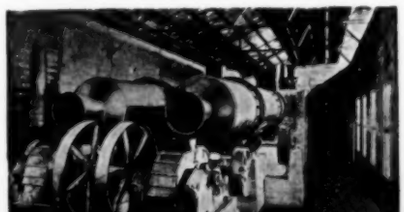

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CHEMICAL & METALLURGICAL ENGINEERING

A consolidation of
ELECTROCHEMICAL & METALLURGICAL INDUSTRY and IRON & STEEL MAGAZINE

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Volume 21 — New York, November 12-19, 1919 — *Number* 12

A Second Double Issue

EDITORIAL announcement was made in the last number of CHEMICAL & METALLURGICAL ENGINEERING of the general plan we intended to follow in printing issues delayed by the late unfortunate pressmen's strike. In pursuance of this policy, this second double issue is in your hands, Volume 21, Number 12, dated November 12 and November 19, but published December 13 *with current news*. Note particularly the last clause; editorial and market pages were closed two days before actual date of publication, and therefore contain material as fresh and readable as though we had never locked horns with the radicals.

Market letters perforce must cover the week ending December 6, while price lists cover the opening on December 8. With an interval between printings of less than a week, the time elapsing between gathering market news and placing it in your hands will quickly be reduced to the interval required by our regular routine.

The President's New Labor Conference

MANY apparently sage observations are made because they will "take" rather than because they are accurate. It has been a habit to assert that improvements can be made in an industry only by those engaged in the industry, despite the fact that many brilliant exceptions could be cited. There has been a disposition to assume that the capital and labor problem could be solved only by the parties getting together. Now the first industrial or labor conference called by President WILSON was marked at the outset to fail in meeting even that requirement, for it did not bring employers and employees together. It brought together representatives of employers, of the public and of labor organizations.

The second conference called by President WILSON avoids representation of either employers or employees as such. It would be the style of some people to say that the second conference is composed largely of "doctrinaires" or "dilettantes," but one can cast a slur upon almost any man or class of men if his hearers are receptive. One might better say that the new conference has in its personnel lawyers, politicians, school masters, even a food administrator.

Actually, the problem is largely psychological. Time after time it has been reiterated, and undoubtedly with truth, that it is not simply wages and hours of labor that are the issue with workmen who are dissatisfied. What, then, will satisfy the workman? At the first conference a strong address was made by one representative, who pointed out among other things that a workman could not be contented if he knew that he were merely a number on a payroll. That is true, but can he have the contentment that produces the best economic results if he knows merely that he is a certain number on the list of members of a labor union? If he is a union man all he can hope for is the things that unions are fitted to furnish, these being two, higher wages and shorter hours, good things in moderation, but, like many others, vicious in excess. Unions are not fitted to produce individual efficiency among their men, they have no system whereby they can secure a greater reward for the member who does better work than other members.

Granted that it is a psychological problem, it can perhaps be attacked better by men who are on the outside but have means of looking at the inside. Many of the members of the second labor conference are readily recognized as men who have a keen insight into human nature, and are presumably able to understand the operations both of the mind of the employer and of the mind of the employed. Given now the assistance of expert investigators and ample time for careful consideration, the chances are good that this conference can lay down a set of eminently fair principles, basic in their relation to the problem and harmonizing with the principles of political economy underlying our republic.

There is one item, in addition, that is very plain. The people of the United States do not want this matter settled by any method except one that will benefit the entire public. The public insists that a question of economics is involved. There are many ways by which differences between employers and employed can be settled to the satisfaction of those two parties, but to great injury to bystanders. The second labor conference at least will be much more disposed by its very constitution to consider the economics of the matter than was the first conference.

Lest We Forget Our Soldier Chemists

A YEAR has passed since the signing of the Armistice and the majority of those who have followed with interest the progress of demobilization undoubtedly feel that the re-assimilation of the discharged soldiers by the industries is now practically complete. While this may be true of industry as a whole, a recent interview with Major F. M. CROSSETT of the Relations Section of the Chemical Warfare Service brought forth the fact that a large number of technical men (the majority of them discharged) are still looking to the Relations Section for aid in securing positions commensurate with their training and experience.

Major CROSSETT'S appeal to employers in need of men

with chemical or technical knowledge and experience will be found on another page of this issue.

Recalling the secrifices made by these men in the service of their country, what is more fitting than that they should receive preference when positions in the chemical field are to be filled?

Union of Thinkers and Workers

IN NOTING the rapid recovery of German business since the Armistice we are reminded of the remark of GLADSTONE to the effect that if hard work is not genius it's a mighty good substitute for it. While experience has taught us to discount largely all varieties of German propaganda, we must not underestimate the achievements of this nation gained through continual effort of its individual citizens.

We are told that the Leipsic Fair of 1919 had the products of 10,000 firms on exhibit and a record attendance of 118,000 persons. Among this number were 7000 foreign buyers. The manufacturers had ready for the market machine tools, agricultural machinery, porcelain and crockery, substitute products such as paper carpets, rugs and table cloths, and jewelry. Prices were from 200 to 400 per cent higher than before the war. A rather hopeless tone existed on the raw materials situation, markedly as regards coal, many plants being idle on account of this shortage of supplies. The chemical works are said to be operating on three shifts daily.

The German people realize that only work can save them. Work is essential to the progress of any nation or individual. But how much better is the combination of work and genius! What heights may not be attained!

The American is by nature ingenious. He is also a worker. But for the happiness of each of us and the progress of all, *the worker must work*, and use his head betimes. The incentive is still there, and when he stops to think about it, he will realize the tremendous things in store for this union of thinkers and workers.

Labor-Saving Machinery In Iron and Steel Industry

THE shortage of common labor in the United States produced by the almost complete absence of immigration for more than five years has naturally directed attention afresh to the matter of the much-mentioned "labor-saving machinery." The iron and steel industry has been seen to employ large numbers of "common laborers," and so one easily jumps to the conclusion that the industry ought now to adopt more labor-saving machinery if indeed it has not been remiss in past years in that respect.

There is nothing in such a conclusion, however, unless it will stand reasonable scrutiny in the light of quantitative facts. It is true the industry employs a large quantity of common labor (not regarding labor as "a mere commodity," of course—it is only the labor unions that want to make it simply a commodity), but the industry is a very large industry. The common labor employed is small relative to the tonnage. Last year was an off year for results, and the 1917 figures of the United States Steel Corporation, the best index that can be used, showed 268,058 persons employed, on an average, with an output of about 14,500,000 gross tons of all steel products. That was just 50 gross tons per person per year. The employment began with the mining of coking coal, as well as a little steam and gas coal, the mining of iron ore and the quarrying of limestone. In included much transportation service and wound up with the shipment of much finely finished material such as wire nails, tin plate and formed sheet products, including all office work. If 35 pounds per day of the average steel products is not much of an undertaking, try it yourself, starting with the coal, limestone and ore in the ground, remembering that you must also sell the material and collect the money for it. The weight of material handled or processed is much greater, and if the weights involved in each operation were added the total would be stupendous. In a great many cases one man is responsible for several tons of material a day going through an operation, and in some instances one man is responsible for hundreds of tons.

From this quantitative viewpoint one discovers a paradox, but at once sees through it, that the employment of labor-saving machinery actually produces the need for a great deal of common labor. The machinery does so much work that the odds and ends left for common labor to do are great relative to the total number of men employed. By no means, moreover, is it always a case of machinery plus the skilled men to operate it replacing a large number of common laborers. For instance, if merchant steel bars were not rolled in practically automatic machinery very large numbers of skilled men would be required to roll the bars. One does not need to depend upon imagination or history to indicate this, for he can see the object lesson in the iron-rolling mill, iron being less susceptible than steel to automatic manipulation. Then, too, there are many instances of the machinery being so automatic that it is a common laborer who operates it. The so-called "common labor" is quite far from being confined to wielding the pick and shovel and pushing the wheelbarrow.

Another means of illustrating the fact that the common labor employed in the iron and steel industry is very small proportionately to the total results accomplished is to point out that if there were no labor-saving machinery millions and millions of men, a number incalculable, would be required, instead of a few hundred thousand. Considering the development of the industry in the past few decades, one is tempted to wander off into a speculation as to how many men the United States or any other country could afford to employ in producing steel. Possibly if it took twice as many men to produce a ton of steel we should have to get along with half as many tons. In other words, there might be more or less of a tendency, in any country, to employ a certain percentage of the population in making steel, whether the output per man were large or small.

In this matter of replacing labor by machinery there is too much disposition to look backward and assume that the remarkable achievements of the past in introducing machinery need simply to be continued. A very great deal of the work has been done. There is more to be gained by looking in other directions, and considering the economic and financial factors. These have a great bearing upon the matter. The workman has been employed when there is work and has been dismissed when there is

none. With machinery capital has been invested and with idleness there is amortization and loss of interest.

If industry were established so that machinery could be kept in steady employment, there would be more machinery used. The man who attended the machinery and worked with it would likewise have steady employment. The change cannot be made suddenly, but there can be progress in that direction, and on the whole there probably is progress. When steel prices are kept from dropping below cost, including liberal overhead, and from advancing to discouraging heights, much progress is made. When money is made more uniformly available, as by the Federal Reserve banking system, the disposition of men to buy much steel in one year and little steel in another is reduced. Improvements like this tend greatly to encourage the installation of labor-saving machinery.

The Cost-Plus Contract In Future Construction Work

THE necessity of finishing the plant and getting it into operation for the production of war material and supplies, regardless of the cost, has brought into prominence the cost-plus-fixed-fee type of contract. Competitive bids were not to be considered on erection of Government plants because the work had to be started before specifications were completed. It was also impossible for private concerns to gamble with the Government for the high stakes involved and during a period of wildly fluctuating markets.

This system of fees has worked out so well for the contractor that it is being generally advocated by individuals and corporations engaged on construction work, and the prospective owners of new works are being confronted with requests for its adoption in all lines where contract is required.

The contractor claims that the cost-plus-a-fixed-fee contract or the cost-plus-a-sliding-fee contract has, among other advantages over the competitive bid, the following: First, it eliminates the element of chance or gamble between owner and contractor: either may lose under competitive bid system; second, work may be started before the plans are completed, hastening completion date and putting the owner's capital to work the more quickly; third, it prevents the many failures of contracting firms: these operate to owner's loss when occurring during the construction period; fourth, the arrangement is fairer to both parties: when saving is effected, both may profit, the owner to the greater extent.

The contractor is perhaps justified in these arguments, the theories seem sound and the employment of this contract is advisable with certain limitations.

The application is practical where the parties at interest are straightforward, conscientious concerns. Universal peace, socialism, pure democracy, free trade, golden rule and all other beautiful theories would also be perfectly practical were all men alive to moral obligations toward others and prepared for the long-expected millennium. But just as the banker must be wary of the occasional dishonest customer, so must the "shrewd business man" be watched. Otherwise contracts would need to exist only as records of requirements and not as binding legal agreements. The most ardent supporters of the cost-plus contract admit the opportunity for dishonesty and admonish owners to seek honest contractors.

It is generally known that a substantial majority of cost-plus contracts executed by the Government did not operate to its advantage, nor yet with fairness to this party of the first part. The incentive to the contractor to perform the work in the most efficient manner was not present; in fact, the contrary was true. Many men of the service now in private life have seen the contractors, and large concerns at that, carelessly waste millions of dollars from the public fund, provided for war purposes, on cost-plus contracts. They have seen workmen employed by these contractors either criminally idle at their jobs, or drawing pay without assignment to work. The driving force was lacking because there was no incentive to create it.

Pleasure automobiles, unnecessary to the work, and living quarters, luxurious beyond all reason, have been furnished their overpaid officials at Government expense. At the time when there was the noble thought of patriotic endeavor to hold them "square" it was considered quite the thing to be careless of public money. Carelessness permeated their entire organizations.

It has been said that losses on war contracts were due to inefficiency of the workman. The truth in most instances was not that he could not do the work, but that he would not do the work. There was no driving force to compel him to work, either in the form of exhortation, fear of losing his job or hope of reward. The contractor did not provide this force as he certainly would had his own dollars been in jeopardy.

This hyphenated contract throws all responsibility on the owner. A contractor is ordinarily retained to do the work because he supposedly has expert knowledge of conditions surrounding the labor and material markets. That's his business, and if he's a real contractor he should be willing to stand on his knowledge of the business. War markets are the exception, of course, but he certainly has no cause to complain on that score. The owner pays him for taking the responsibility and therefore does not expect to do the work for him.

In any type of contract the owner must see that the terms are carried out as intended. On fixed bid agreements this takes the form of an inspection of material and quality of workmanship. On cost-plus contracts the feature of labor efficiency and methods is an added burden and the owner must supervise as well as inspect. This supervision if properly carried out in many cases calls for an organization parallel to and nearly as large as the contractor's overhead construction force. The owner might as well do his own work.

With numerous examples of losses on cost-plus contracts at hand the owner must, then, consider carefully. If he does not have a force of his own available for adequate inspection and the added feature of supervision, he must retain the services of a strictly professional consulting engineering firm, not engaged in the sales or contracting business, which he can rely upon to handle to his best interests. This applies to the smallest contracts.

The cost-plus contract may be the forerunner of a type that makes for a distinct advance in business methods. It would be well, instead of discussing hyphenated terminology, for the contractors' associations to submit some standard detailed forms of this new type. Certainly the war-time cost-plus variety will never be satisfactory to the private owner.

Readers' Views and Comments

Senate Bill 2715, 66th Congress

To the Editor of Chemical & Metallurgical Engineering

SIR: The above bill for the reorganization of the Army stipulates that the Chemical Warfare Service be made a subsidiary branch of the Corps of Engineers of the U. S. Army. It is my sincere belief that this provision will make the United States defenseless against any enemy in war that adopts the use of chemical warfare, whether in breach of convention or otherwise. For the distant future the bill makes provision for a great institute of research, which is be under the jurisdiction of the same corps, and is to encourage men of the greatest scientific attainment in the country to co-operate with the Army. For the immediate future, however, I am under the impression that if the little that remains of the Chemical Warfare Service be joined to the Engineers Corps it will cease to function to good effect. Chemical research cannot be prosecuted in company formation, or under military rule, and even its progress is likely to be invisible, except to the chemically trained mind. The science requires the individual time and attention of him who follows it, and it is in no sense a side issue to be mastered as an incidental study, either at West Point or anywhere else. We have suffered amazing wastes during the war owing to the lack of understanding of chemical reactions by men in authority, and I hold that this branch of the Service, whether gas warfare be forbidden by convention or not, should be constantly maintained, under competent direction, as a measure of national safety. In times of peace the Corps of Engineers is usually engaged in connection with public waterways, or other Federal engineering undertakings, and it stands to reason that the Chief of the Division of Engineers is likely to assign his least useful engineer officers to the supervision of this branch of the Service which, by its very nature, cannot show any good results.

Defensive chemical warfare cannot be studied without equal diligence addressed to the discovery of means of offense. I therefore make bold to urge that the Chemical Warfare Service of the Army be made a separate and distinct branch of the Service, instead of being a department of the Corps of Engineers as provided for in the above-mentioned bill. C. W. S.

New York City.

An Alloy Which Resists Molten Brass and Bronze

To the Editor of Chemical & Metallurigcal Engineering

SIR:—In the Aug. 1 issue of CHEMICAL & METALLURGICAL ENGINEERING there appeared a very live editorial on the subject of "Pyrometers for Brass and Bronze Makers." In that editorial you make one statement, however, which I think is apt to be misleading. The sentence I refer to reads: "An alloy of 25 per cent chromium and 75 per cent iron can be cast into moderately thin tubes, but corrodes in rather an erratic manner."

The alloy to which you refer is manufactured by us and is known as Chromon. It is being used as a protective sheath for thermocouples in measuring the temperatures of molten brass and bronze mixtures. Your statement that the alloy's behavior is erratic is true only when the equipment with which the alloy is used is misapplied. The alloy is rapidly attacked by high-phosphorus bronzes, nor does it give uniformly good service at temperatures above 2200 deg. F. A pyrometer outfit which we sell for this purpose is intended for intermittent use; that is, the protective tip should not be immersed permanently in the molten brass. Used intermittently, most of our users are getting approximately 150 readings before a renewal of the protective tip is required. The brass manufacturers seem to consider this very good service and certainly it allows the measurement of temperatures of molten brass to be made more economically than by any other known method. Of course, it would be ideal if it were possible to use a thermocouple which did not require protection and which could be inserted directly into the molten metal. The well known Chromel thermocouples which we manufacture are probably as resistant to this action as any other alloys, yet it is very unsatisfactory to try to use them without any sort of protection.

Readings can be taken in about ninety seconds or quicker if the protective tip is not cooled off entirely. It is often found not necessary to check every ladle and some users prefer to check only when changing to a different alloy or to a different casting. For instance, the proper pouring temperature can be determined for a certain job, and after the first few ladles are checked, and the job is going well, it is necessary to measure only the temperature of every third ladle. It is entirely possible to hold a ladle of brass long enough to take the temperature, and it just as often happens that the metal will be found too hot rather than too cold. One ladle cast at the wrong temperature, at least on certain jobs, will pay for the cost of making a very large number of temperature readings on castings poured at the right temperature.

These comments are presented, not to criticize the editor for holding high ideals, because we appreciate that he is in a position to state the needs of the art and that he has done so very clearly and well. However, we believe that the temperature of molten brass can be satisfactorily determined day in and day out with the help of this Chromon alloy, and, barring the usual opposition to innovations in the foundry business, it is being done to the decided advantage, both of the piece worker and the manager.

HOSKINS MANUFACTURING CO.,
Per Charles S. Kinnison.

Detroit, Mich.

Tests at Watertown Arsenal

Testing of materials for industrial purposes at the Watertown Arsenal showed very large increase during the fiscal year ended June 30, 1919. Development has been carried out not only along metallurgical lines, but in all phases of work, including the development of cutting oils and the examination of quenching media. During the fiscal year the total number of specimens tested was 43,964. This is an increase of 259 per cent over the work done during the preceding fiscal year. The total number of chemical analyses for the fiscal year ended June 30 was 48,339. This was an increase of 522 per cent over the figures of the preceding fiscal year.

Western Chemical and Metallurgical Field

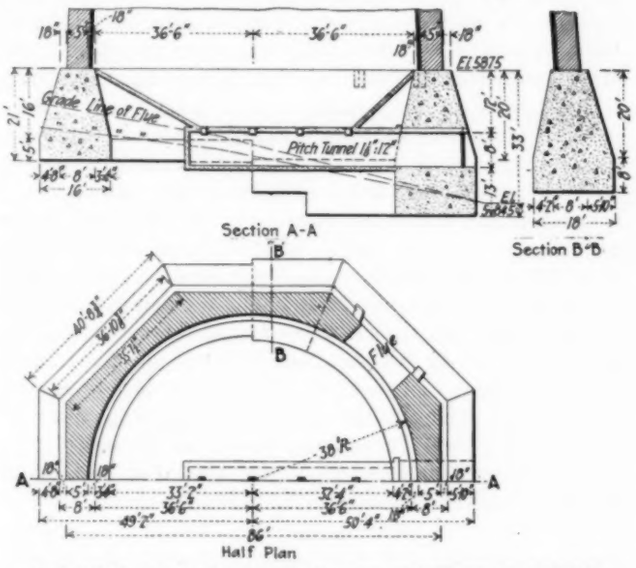
Details of Anaconda's Chimney

ANACONDA'S newest "big stack," with its smoke purification system, went into service during the summer, giving the expected clearance almost from the start. A brief description of this largest project in dust collection was given in our issue of April 15, 1918 (Vol. 18, p. 392), and the accompanying drawings of the chimney more recently appeared in *Engineering News-Record*, for Oct. 23, 1919 (Vol. 83, p. 764), by courtesy of the Alphons Custodis Chimney Construction Co., the designer and builder.

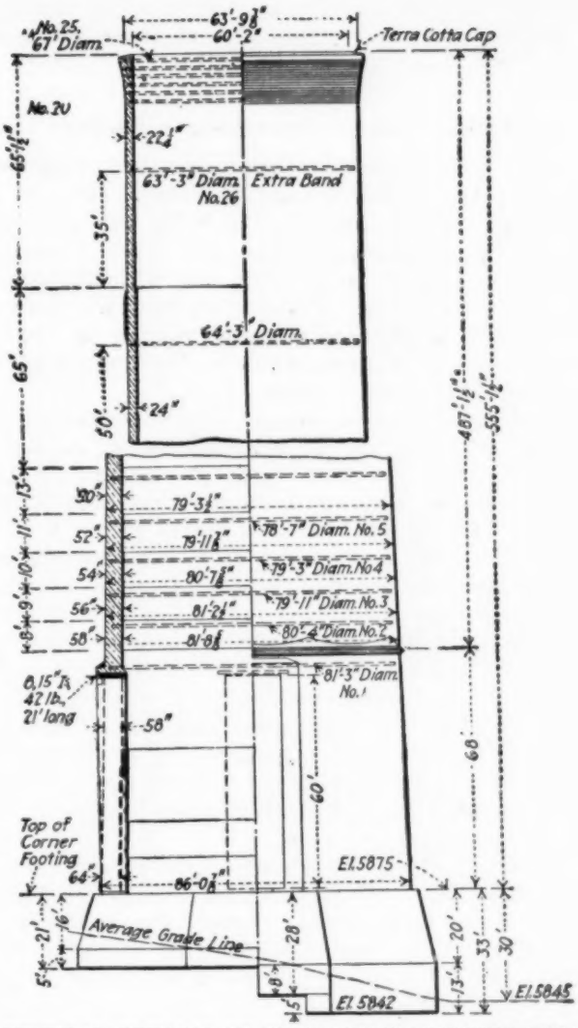
Little can be added to the details given on the drawings. As shown in the drawing and in the accompanying view of the base of the Anaconda chimney, the concrete base is octagonal in shape, 89 ft. outside top diameter and from 10 to 30 ft. above the ground. On it an octagonal brick section 86 ft. in diameter and 68 ft. high carries the circular tapering brick chimney, rising as shown to a total height of 555 ft. The main shaft has five different tapers, and the thickness varies from 58 in. at the top of the octagonal section to 22½ in. at the top, under the terra cotta cap. The concrete base reaches down to a good rock foundation, with a load of about 7.5 tons per square foot.

Fine clay-like flotation tailings mixed with coarser table-tailings sand was used for making the brick. In order to handle this job, the brick department was moved from the west end of the town to the flat alongside the slime pounds, there to be near the source of brick-making materials and point of consumption. Modern machinery was installed and the brick burned at about 1800 deg. F. (1000 deg. C.) in a continuous kiln. About 17,000 tons of radial perforated blocks were used in the chimney proper. Acid-proof mortar made of lime-free materials required 10,350 bbl. of portland cement, 1850 tons of fire clay and 2700 cu.yd. of siliceous sand; 1:3:5 concrete was used in the foundation.

The annexed table gives some general details of the two "big stacks" at Anaconda, together with other notable chimneys built in the West in recent years, whereby some idea of the comparative size of modern stacks may be had. In 1903 the 300-ft. brick stack at Anaconda, standing on a hill behind the new Washoe plant, was one of the seven wonders of the smelting world! Tacoma has the palm for extreme height, but none of the others approach the bulk of the 506-ft.



DETAILS OF FOUNDATION FOR WASHOE CHIMNEY



GENERAL DETAILS OF HIGH BRICK CHIMNEY FOR WASHOE SMELTER AT ANACONDA

TABLE I—DATA ON RECENT NOTABLE CHIMNEYS

Plant	Year	Clear Inside Diameter		Wall Thickness		Height Above Foundation Ft.	Material
		Top	Bottom	Top Inches	Bottom Inches		
Anaconda	1903	30 ft.	31 ft., 4 in.	12½	62*	300	Common brick
Anaconda	1918	60 ft.	76 ft.	22½	64	555	Radial blocks
Great Falls	1908	50 ft.	66 ft., 6 in.	18½†	66†	506	Radial blocks
El Paso	1917	30 ft.	34 ft., 6 in.	13	38‡	400	Common brick base 80 ft. high and radial brick column
Helena	1917	16 ft.	25 ft., 3½ in.	11½	44	400	Anaconda radial brick
Tacoma	1917	23 ft., 11 in.	39 ft.	13½§	61§	571	Paving block brick
Murray	1917	19 ft., 9½ in.	38 ft., 4 in.	...	...	455	Radial brick
Saganoseki	1917	26 ft., 3 in.	37 ft., 9 in.	7	29½	570	Concrete

*Plus self-supporting lining 145 ft. high, 12½ in. thick at base, 8 in. thick at top.
†Plus 4-in. lining to top.
‡Lined with 4-in. radial block for 125 ft.
§Plus 4½-in. lining to top.

chimney built at Great Falls in 1908, or the newer and larger one built ten years later at the other smelter of the Anaconda Copper Mining Co.

By-Product Tar as Open-Hearth Furnace Fuel

Two innovations in their regular open-hearth practice were made at the Minnequa plant of the Colorado Fuel & Iron Co. in 1918 and have been successfully maintained since that time, namely, the use of by-product tar as fuel, and of molten spiegel as a ladle addition. Frank Ferguson has described these improvements in a recent number of the company's organ, *Industrial Bulletin*, from which the following information is taken.

"The spiegel plant was put into operation on Aug. 5, 1918, it being the third installation of its kind in this country. The basic idea of the process is to melt down an alloy of a constant chemical analysis that is carried into the open-hearth pit in a molten state and added to the steel as it runs into the steel ladle from the furnace proper, thereby practically eliminating the production of 'off-grade' high carbon in rail heats, and making for a more uniform manganese in the finished steel and less variation in both the carbon and manganese from heat to heat.

"It is also more economical and has increased the efficiency of rail-melting practice fully 10 per cent, the month of April of this year being the best month the department ever had on rail steel, when it made 93 per cent good rail heats.

"The use of tar in the open-hearth furnaces went into effect July 18, 1918. As a comparison between gas and tar, producer gas comes into the furnace as a big, full bodied flame by the pull of the stack on 40 to 60 lb. of steam pressure at the gas house, while tar makes a thin, light flame delivered into the furnaces under terrific pressure. The tar comes through the lines at 80-lb. pressure, while at the furnace where the tar goes into the burner or 'gun' it is broken up under 50-lb. steam pressure.

"Tar makes a much hotter flame than producer gas, therefore the tonnage is increased, but being so much hotter than gas, the furnace burns out quicker. From an economical standpoint, the comparison of one tar furnace and one gas furnace shows that the advantage is slightly in favor of the tar furnace.

"The main advantage of tar is in using it on the furnaces every week when the gas sewers are burned out, thereby keeping it in operation instead of shutting down for 12 hours once a week; also in using it on a furnace that it is impossible to run with gas. As an illustration, a short time ago the south end of No. 11 furnace fell in, completely blocking the slag pockets and checker-chambers, making it impossible to run the furnace under those conditions with gas. Tar was put in the furnace and it ran three weeks and four days and made comparatively good time."

Present Strength of Chemical Warfare Service

In announcing the allotment of the funds carried by the Army Appropriation bill for the current fiscal year, the Secretary of War has designated 124 officers and 1348 enlisted men as the strength of the Chemical Warfare Service for the fiscal year.

The Laboring Man and the Mails

WE PRINT elsewhere in this issue an address by a Senator on the postal-zone system. We do not want to weary our readers on this subject, and we have refrained from discussing it more frequently, solely because it might seem that our own interest is more immediate and pressing than that of our subscribers. At the same time we believe that the ultimate effect of this restriction on the use of the mails will be far more harmful to the people at large than to the publishers of periodicals. Let us study the question.

In our issue of Sept. 15, we gave a record of a visit to Newark and a report of the work on Americanization undertaken by the manufacturers of the so-called Ironbound district. There and elsewhere it has been discovered that a vast number of foreigners who can neither read nor speak English get anarchistic papers printed in their own language, and that this Bolshevist propaganda is the only newspaper or periodical literature they are able to read at all. The publishers of such papers do not register them as second class matter; they distribute them secretly because the mails are not open to the advocacy of arson and rapine and murder—which is the very substance of the doctrines of the Reds.

Duty to Foreign Residents Neglected

We believe that as a people we have neglected our duty in regard to foreign residents. We have left them alone when we should not have done so; we have neglected these smouldering fires until now they threaten to break out in a social conflagration. An observing man of our acquaintance has been wandering about the East Side of New York of late, and every night at one place or another he hears the gospel preached that capital and labor are at enmity and cannot work together for the common good; that our government, laws and institutions are all capitalistic and consequently wrong; that the ballot has lost its potency, and that its only usefulness is to elect revolutionists, who will preach the doctrine of anarchy until the day for the break-up of government and order shall be at hand. And nobody takes the trouble to contradict it! We accept our share of the blame for this, for we are all blameworthy. It is time for us to get busy and put out the fire; and it cannot be done by means of policemen. We must come back at our erring neighbors with arguments more effective than Thou Shalt Steal, and Thou Shalt Kill. We must do it in languages that very few of us can speak, and it must be done chiefly through the mails.

To those of us who have ever attended a Left-Wing Socialist meeting and compared it to a regular Republican or Democratic Campaign Hurrah, the result is humiliating. These anarchists of one phase or another are many of them sincere, and many truly believe that the destruction of all governments such as we have is the true way of betterment. Others who can't get ahead or who have got themselves in wrong expect to be leaders or dictators in disorder. They abide in darkness for their own profit. But all use their minds at these meetings, and use them with an astuteness that would confound a seasoned old campaigner in five minutes. There's no use in getting angry over it, because the price of anger is failure.

Now let us consider a few theories, a few facts, and possibly a few arguments connected with them, with a view to starting better trains of thought.

The Reds all hark back to Karl Marx in dividing the people of the civilized portions of the earth into two groups: the capitalists and the proletariat. Associated with the capitalists are the bourgeoisie who are classed with them. All wealth, they say, is produced by labor, and it is the proletariat who should enjoy it, because labor alone produces it. In a Socialist state, the proletariat, being in the majority, will rule, and the government will control production and distribution, in addition to its other functions. Socialists are divided between the Right Wing and the Left Wing, of which the former believe that the way to achieve the desired reforms is by the ballot and legislation. The Left Wing is the radical section, and believes that the desired reforms are only to be accomplished by revolution. The Communists are of the same opinion as the Left Wing.

Proletariat an Inharmonious Body

The proletariat, however, contains not only the ignorant, the inexperienced and the uneducated, but a vast majority of the feeble-minded. This fraction is so large as to make the proletariat an inharmonious body within its own ranks. It contains also many intelligent persons who want to get ahead and become men of circumstance. We may almost say that a majority of our best citizens who have achieved recognition and affluence started as workers with their hands, and so come from the proletariat. It is no disgrace to be of it, or to work with our hands. And when we consider the scale of wages now current, it is a profitable thing to do. On the other hand, the feeble wits cannot even understand that it is not only unethical but unprofitable to break a contract. They are not even intelligent enough to keep a promise, whereas the man with a future before him wants to keep his record clean. These straightforward ambitious workers and the half-witted sloths never have got along together, they do not get along together now, they never can get along together, and they never will. There is intelligence of the highest order among the proletariat, but the average is too low for reasonable government by them. This is one of Marx's great errors. We can have revolution and anarchy and dictatorship following; but we cannot have intelligent rule or competent and proper supervision from the men and women who make up the proletariat today. The percentage of morons is too high. We need all the intelligence available in the election of representatives or members of soviets, or whatever we want to call our men and women to whom the administration of government is entrusted. We make some pretty bad mistakes as things are.

According to Professor Millekan, who quotes a progressive economist as his authority, if all the incomes in the United States were completely leveled, so that a hod-carrier and the president of the United States Steel Corporation received exactly the same wage, and all our millionaires received the same as these two and no more, the increase in the pay of the average worker would hardly rise above 10 per cent.

In this respect, also, the Reds are all wrong. Let us, for the sake of argument, grant them everything they ask for, and imagine a government according to their own desires, and postulate the impossible, which is industry under Bolshevist rule and productive at the same time. Even then there would be no rich men's luxuries, such as expensive automobiles, grand pianos and the like, for the proletariat. The only person who could have them would be the few that they would elect to power and wealth. There's nothing of the sort for the common man in the Socialist state, and it would be harder to get elected then than it is now. A study of the telephone industry of the country brought out the fact that a similar leveling would increase the income of the wage earners by no more than from 2 to 3 per cent.

Let us borrow some more ideas from Professor Millekan in his address to the Summer School at Chicago this year. It has been generally admitted that the living conditions of the average American workingman and his family are better than the average living conditions of such men in Europe. This is not due to better distribution of wealth, because we have made a greater number of rich men here than any other country. It is due to the increased production of material per man here, because of great national resources and the use of labor-saving machinery; to geographical location, and to the inventions of single men. Look at such little things as the discovery of ductile tungsten, which makes electric light one-third as expensive as it was before! That was not accomplished by vote or by revolution. It was the work of very few men, and all are benefited by it. Most of our increase in wealth comes from just such single steps which cost great energy and labor to bring into general use, and which nobody will undertake unless he can get a reward for it. Distribution of wealth is a subject of vast importance, and things are not right as they are. The allotment is not fair in accordance with services rendered, but revolution and Bolshevist rule will not provide any improvement in the condition of the man who works with his hands. In fact, without the inventions and foresight and courage of our exceptional man he will not even have a job.

Now these vicious ideas that the road to independence and well-being is through theft and riot and murder are largely held by our foreign population who do not have the chance to read anything else. As for their American leaders, we are learning how to deal with them; but what the foreigners most need is enlightenment. They live in communities scattered all over the country. They can be reached by literature published in their own languages. The zone system of the post-office taxes this very effort.

The A. C. S. Chicago Section Directory

The Chicago Section of the American Chemical Society has published the 1919 Directory of Members—the largest yet issued. It contains a list of awards of the Willard Gibbs medals, the past officers of the section, a copy of the constitution and by-laws, a directory of the members with personal record opposite each name, and a classified index of members according to occupations and industries. The classified index as well as the personal records of the members is particularly complete. The booklet is a valuable aid to the industry in the Chicago district and an example by which the national societies may well profit.

Col. Joyes on Nitrogen-Fixation in Europe During the War

ONE of the most remarkable attainments of the war, according to Col. J. W. Joyes of the Nitrate Section of the Bureau of Ordnance, who recently returned from a trip to Europe with the United States Fixed Nitrogen Commission, was the development by the German Badische Anilin und Soda Fabrik of Prof. Haber's synthetic ammonia process. This was only one of the many interesting observations made by the Commission during its visit to France, the portion of Germany occupied by the Allies, England, Norway and Sweden. Much information has been brought back as to the development of the processes of fixation and as to the use of the several marketable products, especially in explosives manufacture and in the fertilizer industry.

The Badische Anilin und Soda Fabrik operated plants at Ludwigshaven and Merseburg. Concerning its development of the Haber process Col. Joyes says:

"This process involves a number of most interesting steps in chemical manufacture. The outline of the process is generally known as the production of a mixture in suitable proportions of nitrogen and hydrogen gases and the combination of these into ammonia. All chemists know the difficulties involved in the necessity for using a catalyst to stimulate the reaction, which even then must be at high pressure and temperature, and get commercial results, and the necessity for having the gas mixture most carefully purified in order to avoid poisoning the catalyst.

Plants Run Successfully Under Government Stimulation

"The Badische plant, existing on a small commercial scale at the commencement of the war, was greatly expanded under government stimulation when the probable inability to bring in enough Chilean nitrate for war needs became apparent.

"The plant at Ludwigshaven, which was visited by the Commission, was not in operation, but the Commission had an opportunity to get a fair general idea of its magnitude, of the difficulties encountered, and of the apparent success with which they had been met. As it stands, it is said to have a capacity of over 200 tons of ammonia per day, and has installations for using this to make nitric acid, sodium nitrate, and several other products useful in agriculture as fertilizers, and in munitions and other manufactures.

"The plant is reported to represent an investment of several hundred million marks of the Badische company's capital, and undoubtedly a substantial government subsidy. Notwithstanding the fact that the works give an impression of great complexity and therefore of large requirements in skilled and other labor for operation and maintenance, there is no doubt that whatever operating troubles occurred, and there must have been many, the plant did produce the much-needed ammonia. And if the statements made as to the writing off during the war of a substantial portion of the value of the plant be true, it must be credited with commercial success under conditions of war. How this and the smaller establishment at Merseburg will meet the competition of the future, with the accompanying high prices for materials and labor, of course remains to be seen."

Vigorous efforts are being made in France, the Commission found, to use cyanamide, as such, as a fertilizer. In that connection, Col. Joyes says:

Cyanamide as a Fertilizer in France

"During the war a number of cyanamide plants were built or commenced in France by private corporations and by the government. Some of these were not finished at the time of the armistice and will not be available for production in the future, but there still remains in France a considerable increase in the capacity for manufacturing cyanamide due to the war. Prominent officials of the French Government are keenly alive to France's needs for a more efficient agricultural system using much more fertilizer than heretofore. There has been much effort to stimulate the use of fertilizer by pointing out its advantages and by scientific research and demonstration. Arrangements have been made for marketing a considerable quantity of the cyanamide produced by the French Government in order that this cheap nitrogen compound made available by the war shall not be lost to agriculture. Although some portion will be converted into the more popular form of ammonium sulphate, etc., vigorous efforts are being made to induce farmers to use the cyanamide as such on account of the great economy in so doing.

"For years Germany has been stimulating, by governmental research, demonstration and publications, the use of cyanamide itself as a fertilizer. These efforts did not cease during the war, but were continued, and it appears that they have had a marked effect inasmuch as the German farmers are using cyanamide for direct application to the soil to a considerable extent. Although many of Germany's cyanamide factories, the capacity of which was greatly increased during the war, are now idle for lack of raw materials principally, these factories remain available to produce a great quantity of this cheapest form of fixed nitrogen fertilizers."

Plant Development in Norway

Development of Norsk-Hydro arc plants in Norway and in the Pyrenees called for particularly complimentary references from Col. Joyes. Concerning them he said:

"Especially interesting from a civil engineering standpoint were the water-power developments of the Norsk-Hydro arc plants at Rjukan, Norway, and of M. Ferdinand Gros in the Pyrenees Mountains in Southern France. In the former of these, water from a lake high in the mountains was used successively in two 100,000-kw. power plants, each with a head of 250 meters, and later in several other plants with lower heads. In the latter, M. Gros has tapped a lake in the Pyrenees fed by perpetual snow, and after successfully overcoming the difficulties of leading this water something over twenty miles through quite rough country, is able to use it with a head of about 800 meters, developing about 30,000 kw.

"M. Gros, a most progressive Frenchman, who has become noted for his introduction and production of liquid NO_2 during the war for use with benzine in air bombs, expects to use the Pyrenees power above mentioned in a new factory, now nearly completed, where he will make cyanamide for fertilizer use, and also other products."

Cyanamide-producing capacity increased materially in Scandinavia during the war, the Commission found. Concerning their observations there, Col. Joyes says:

SCANDINAVIA'S INCREASED OUTPUT

"The plant of the Norsk-Hydro company's celebrated Birkeland-Eyde arc-fixation process was practically doubled in 1915-16. This plant makes calcium nitrate as its principal normal product, which is used in Norway especially as a fertilizer for direct application to the soil. It has also been sold during the war to munitions manufacturers. This plant was one of the most interesting seen on the trip, as it demonstrates on such a large scale how a process with an extremely low technical efficiency can, under favorable circumstances and with clever engineering, be made to yield a handsome profit. This plant has enormous capital invested with most advanced hydro-electric and electrochemical installations in substantial buildings of handsome and suitable design."

Valuable scientific research on the fixation problem was done in England during the war. If the war had continued, England would have constructed several establishments to use some of the available processes.

The Fixed Nitrogen Commission, which was charged with the duty of obtaining information as to the present state of nitrogen-fixation development in Europe, consisted of Col. J. W. Joyes, Ordnance Department, U. S. A., chairman; Lt. Col. A. B. Lamb, C. W. S.; Lt. Col. F. H. Wagner, Ordnance Department; and Capt. R. S. Tour, Ordnance Department.

de Freminville on Mechanism of Fractures

At the 40th annual meeting of the American Society of Mechanical Engineers, held Dec. 4, in New York, Charles de Freminville, consulting engineer to the Creusot Works, France, read a paper on the "Reliability of Materials and Mechanism of Fractures." He noted that the first motor cars were cumbersome, heavy contrivances, principally because they were made of ordinary carbon steels with usual factors of safety. The problem, then, was to replace heavy parts like gears or crank shafts, which were subjected to severe but normal work, and second, parts like axles and wheels which normally were stressed very slightly but may at any time be given severe shock. Such parts should better bend on overstrain than break, and the bending should be easily perceived and the part replaced.

Therefore, about 1901, various steel plants began production of alloy steels of high strength and which tested well under ordinary conditions. However, many puzzling failures were observed in service, not only of the new alloys, but many dangerous fractures of mild steels began to appear. Fremont's impact test, originally developed for soft materials, was therefore adapted to test hard metals, and this quick-bend test has since rendered service of extreme importance in eliminating unsafe metal from automotive construction.

Consideration of shock-fractured ductile metals revealed striking similarity to breaks in glass, quartz or bitumen. The last was particularly handy for experimental work, being easy to mold, when warm, into any required shape. In such media, illustrative breaks were shown by the speaker to develop quite symmetrically, fanning out from the first rupture in a definite pattern. Conversely, this "focus" of rupture, identified with the point which gave way first, could easily be located by the convergence of the rays and surfaces of fracture.

Passing to the consideration of thick pieces of metal broken under impact, the focus of rupture is at the side opposite that receiving the blow, but strangely enough, at a material distance inside the surface of the piece, a fine silky area intervening. From this point the material apparently splits along a series of substantially smooth surfaces, sometimes overlapping, and sometimes separated by ripples which further out develop into major fracture planes.

Relations Section, Chemical Warfare Service

BY MAJOR FREDERICK M. CROSSETT

Many men are being discharged from the Army who before entering service were engaged in work requiring chemical or technical education and experience. Nearly all are college or technicel school graduates with practical experience. They also have had the benefit of Army training and discipline and, in some instances, the handling of men, research work or chemical engineering. Some of them are anxious to secure employment.

To help them the Relations Section of the Chemical Warfare Service is acting as a clearing house. From the applicants (from all over the country) there is a rare opportunity to select splendid men of exceptional ability, who are well qualified to fill any place requiring chemical or technical knowledge and experience. Some seek places as executives, engineers, superintendents, plant operators, foremen, supervisors and salesmen.

When men are wanted preference should be shown those who have served their country in the war. Kindly employ and recommend them when opportunity occurs.

Do you need a man? If so, please send full details of your requirements. We have them from $1200 to $12,000 a year. A line to the Director of Chemical Warfare Service, Washington, D. C., will bring prompt attention.

Increased Cost of Printed Copies of Patents

The following notice has been received from the Commissioner of Patents:

H. R. 9205, a bill "making appropriation to supply deficiencies in appropriations for the fiscal year ending June 30, 1920," etc., which was approved Nov. 4, 1919, contains the following provision:

"That hereafter 10 cents per copy shall be charged for uncertified printed copies of specifications and drawings of patents."

The act of Feb. 20, 1905 (as amended), relating to the registration of trade-marks, provides in Sec. 14 that the fees shall be: "For certified and uncertified copies of certificates of registration and other papers, and for recording transfers and other papers, the same fees as required by law for such copies of patents and for recording assignments and other papers relating to patents."

You are therefore notified that this provision having become effective, the charge for printed copies of patents, trade-marks and designs shall be 10c. each.

Five-cent coupons will be accepted at their face value in payment for copies. In ordering a copy on five-cent coupons, it is only necessary to fill out one such coupon, the other being blank and used in lieu of cash.

House Passes Longworth Dye Bill

Just before passing the Longworth bill providing for the regulation of imports of coal-tar products, the House of Representatives, on Sept. 26, approved, by a vote of 207 to 62, an amendment by Representative Cannon of Illinois placing the licensing system created by the bill in the hands of the Federal Tariff Commission. The vote was non-partisan, the plan of having the Tariff Commission handle the licensing being opposed and supported by members of each party. The motion to recommit the bill and bring out a substitute prepared by Representative Kitchin, the ranking Democratic member of the Ways and Means Committee, was voted down 159 to 115. Mr. Kitchin's substitute carried lower rates of duties, but also provided for a licensing system and that it be administered by the Tariff Commission.

While the Democrats objected to the schedule of rates proposed in the Longworth bill, the main opposition to the measure came from within the Republican ranks and was directed against the licensing feature of the measure. This opposition was led by Representative Moore of Pennsylvania. No record vote was had on the licensing proposal, but amendments to that effect were voted down. A rising vote in the committee of the whole showed 86 for the licensing system and 53 against it; a later vote by tellers showed 94 for and 54 against the licensing plan, which defeated the proposal of Representative Moore to strike out the section which authorizes licensing. This made it impossible then to secure a record vote when the bill was considered in the House proper.

Representative Mondell, the Republican floor leader, in replying to the criticisms of the license system, said in part: "The Republican party will always adhere to the protective tariff system. It is carrying it out in this bill, but in connection with the industry proposed to be protected in this bill, a condition was found requiring temporarily the use of a policy of licenses in order to accomplish the very thing that a protective tariff does. It has been said that it would be possible to make the tariff rates high enough to obviate the necessity of a licensing system. That is true, but no one would be justified in voting for a tariff rate high enough to protect these industries in the immediate future. Rates could be made so high as to be burdensome to the enterprises using dyes. We do not want to burden those who must use dyestuffs, but we are desirous to build up a dyestuff industry, therefore the temporary expedient of adding to our tariff this provision for licensing. I think a manufacturer who depends for his business on the protective system should be willing to go to a little trouble to comply with the provision of a licensing system temporarily, if that licensing system is essential to the development of the protective policy."

The matter of turning the administration of the licensing system over to the Tariff Commission brought forth many acrimonious exchanges during the consideration of the bill. It was brought out that Chairman Page of the Tariff Commission believes that the Commission is wholly unfit to administer the law. He holds that the work of the Commission is of a research nature and that it was not planned to take over the administration of the licensing of dyestuffs. In fact, he believes that it will destroy the Tariff Commission. On the other hand, William S. Culbertson, regarded by many as being the brains of the Tariff Commission, is strongly in favor of having the administration of the dye licenses placed in the hands of the Tariff Commission.

Meeting of the Society of Chemical Industry

The meeting of the American Section of the Society of Chemical Industry, held at Rumford Hall, New York, Nov. 21, was unique in the excellence of facilities for demonstrating the papers of the evening. Mr. Henry B. Faber in his paper on Industrial Filtration showed how valuable preliminary data could be obtained by the use of a one-sixth of a square foot paddle leaf. With a small electric suction pump, a graduated Woulff bottle and the single filter leaf, he was able to find the rate of filtration and the required wash water per unit area. Mr. Faber gave three classes into which most filtering problems can be divided: Slow filtering slurries, rapid filtering solutions and very rapid filtering granular products. For the first, the regular filter press is applicable. The open tank filter designed by George Moore, as well as the self-dumping type of filter, offers advantages when trouble is not likely to occur with the cloths or filtering diaphragms. The rotary filters find universal application in the second class and the centrifugal in the third. In washing the cake, Mr. Faber strongly recommended agitation with the wash water and refiltering, because the wash water can seldom be homogeneously driven through the cake.

Dr. Allen Rogers gave an illuminating account of the recent activities of the Ocean Leather Co. Two reels were given illustrating the methods used in catching sharks, turtles, etc. It is planned to publish a complete description of the processes, products and applications of fish leather in an early issue, so an abstract will not be given here.

Mining & Metallurgical Society of America Honors Charles Eugene Schneider

Charles Eugene Schneider was presented the Gold Medal of the Mining and Metallurgical Society of America at the conclusion of a testimonial dinner in his honor in New York, Nov. 24, 1919. Joining in the occasion by the attendance in a body of their presidents, boards of directors and secretaries, together with a large number of their members, were the national societies of Civil Engineers, Mining and Metallurgical Engineers, Mechanical Engineers and Electrical Engineers.

The distinguished French ironmaster declaimed any greatness except that thrust upon him, and paid glowing tribute to the thousands of associates and employees whose cheerful co-operation made possible the rapid recovery of French munition works after the first tide of German invasion. This spirit of co-operation between men of democratic lands was, in his idea, the hope of future peace.

Bradley Stoughton spoke of the former medalists and the significance of the token; Dr. Henry M. Howe recounted the technical achievements of the guest of honor; Charles M. Schwab spoke in a reminiscent vein of the open-hearted aid rendered by the Creuzot Staff to those at Bethlehem in its adolescence, while Col. Manus McCloskey told graphically the use to which the allied artillerists put the "75's," "long Schneiders" and "short Schneiders" in the late argument with the Hun.

Wood Ashes and Production of Potash

Data on the Potash Content of North American Woods — Details of the Manufacture of Wood Ash Extract — Estimate of the Cost of Manufacture

By ERNEST BATEMAN

DURING the period of the war much has been written on the subject of potash, its needs and the various sources from which it has or might be obtained. A few articles have appeared on the subject of potash from wood ashes. There seems, however, to be no article which brings together the available analyses of wood ashes and a detailed description of the methods used in preparing potash from them and it is felt that such a contribution would be of distinct usefulness. It is, therefore, proposed to bring together in this paper as much of the data on wood ashes and the production of potash from them as it is possible to obtain.

The best determinations of the ash content of American species of wood are those given by Sargent. From the list published by Sargent, the least important species have been omitted. The rest appear in Table I.

There are but few published analysis of pure wood ashes from known species. The best and practictically the only reliable figures on the analysis of American wood ashes by species arethose given by White.[1] White analyzed a number of woods, being very careful to have them clean and dry and free from bark. The results, given in Table II, were obtained from only one sample of wood for each species. In the softwoods, figures are given for longleaf pine (Pinus palustris) and shortleaf pine (Pinus mitis or Pinus echinata). More than half the lumber-cut of the United States in softwoods is probably of these two species. In the hardwoods, several oaks are given and more than half of the lumber-cut in hardwods is oak. It is believed, therefore, that a fair idea of the amount of potash obtainable from the waste in lumber operations and from firewood can be obtained by using these averages.

The lumber-cut of 1915 was approximately 25,400,000,000 ft. b.m. softwoods and 5,800,000,000 ft. b.m. hardwoods. If we estimate that 25 per cent of this material reached the burners, then the total waste calculated to cubic feet is 527,500,000 cu.ft. of softwoods, and 120,000,000 cu.ft. of hardwoods. The annual consumption of firewood is about 71,000,000,000 cu.ft., of which approximately half, or 35,500,000,000 cu.ft., was estimated as hardwoods. Calculated on this basis, the total amount of potash annually produced by the burning of wood is as is shown in Table III.

Unfortunately, however, a very large proportion of this is not recoverable. Much of the potash in waste wood is volatilized* during the burning, while another large portion is carried up the chimney as fine dust. This is particularly true of softwood waste; practically all of the ashes resulting from softwood is lost. More than 80 per cent of the wood that goes into firewood is used on farms, the ashes resulting being used in all probability as fertilizer, so that they cannot be considered as taking the place in the potash industry of that which we formerly imported. Of the total amount of ashes produced from wood burned as fuel perhaps not more than 15 per cent could be collected.

Wood ashes as they appear on the market are obtained from stoves or boilers and are quite different from the

*It does not seem probable that the amount of potash lost by volatilization and dust can be decreased very much with present-day practice, because to reduce the intensity of the heat and draft would mean a redesign of the boilers and waste burners now in use. It is believed this would be much too expensive to make any such process economical in view of the small amount of potassium available. The useof the Cottrell process for precipitating the dust would also require new design of waste burners. Futhermore, calculations show that if the temperature of the flue gases is 200 deg. C. then the maximum amount of potash obtainable, if it were all volatilized or carried off as dust, would be approximately 1 lb. for every 400,000 cu. ft. of gas treated.

TABLE I. VARIATION IN ASH CONTENT OF SELECTED SPECIES OF WOOD

Species Common Name and Botanical Name	No. of Analyses	Ash Content — Minimum	Ash Content — Maximum	Ash Content — Average Per Cent
Cucumber tree (Magnolia acuminata)	5	0.25	0.34	0.29
Yellow poplar; tulip tree (Liriodendron tulipifera)	11	0.16	0.32	0.23
Basswood (Tilia Americana)	5	0.31	1.02	0.55
White basswood (Tilia heterophylla)	4	0.45	0.86	0.62
Decidirous holly (Ilex decidua)	5	0.47	0.84	0.70
Indian cherry (Rhamnus caroliniana)	4	0.19	0.98	0.64
Soapberry (Sapindus marginatus)	4	1.35	1.69	1.50
Sugar maple (Acer saccharinum)	9	0.31	1.02	0.54
Black maple (Acer saccharinum nigra)	7	0.39	1.25	0.71
Silver soft maple (Acer dasycarpum)	4	0.28	0.41	0.33
Red maple (Acer rubrum)	5	0.25	0.49	0.37
Judas tree (Cercis canadensis)	5	0.58	0.79	0.72
Mesquite (Prosopis juliflora)	4	1.69	3.02	2.18
Black cherry (Prunus serotina)	12	0.08	0.25	0.15
Laurel (Prunus caroliniana)	6	0.33	0.48	0.41
Red gum (Liquidamber styraciflua)	6	0.32	0.81	0.61
Dogwood (Cornus Florida)	5	0.56	0.80	0.67
Tupelo (Nyssa sylvatica)	8	0.33	0.84	0.52
Tupelo (Nyssa uniflora)	4	0.59	0.74	0.70
Persimmon (Diospyros virginiana)	5	0.77	1.04	0.96
White ash (Fraxinus Americana)	26	0.24	0.72	0.42
Red ash (Fraxinus pubescens)	5	0.20	0.42	0.26
Green ash (Fraxinus viridis)	5	0.55	0.81	0.65
Blue ash (Fraxinus quadrangulata)	8	0.61	0.96	0.78
Oregon ash (Fraxinus oregona)	4	0.14	0.73	0.34
Black ash (Fraxinus sambucifolia)	5	0.47	0.89	0.72
Hardy catalpa (Catalpa speciosa)	10	0.31	0.48	0.39
Sassafras (Sassafras officinale)	6	0.05	0.15	0.10
Red elm (Ulmus fulva)	10	0.12	0.27	0.83
White elm (Ulmus Americana)	7	0.48	0.02	0.80
Rock elm (Ulmus racemosa)	6	0.34	0.81	0.60
Hackberry (Celtis occidentalis)	8	0.68	0.89	1.09
Butternut (Juglans cinerea)	8	0.33	0.79	0.51
Black walnut (Juglans nigra)	11	0.12	1.96	0.79
Shagbark hickory (Carya alba)	16	0.28	1.14	0.73
White oak (Quercus alba)	31	0.23	1.51	0.41
Post oak (Quercus obtusiloba)	7	0.49	1.56	0.79
Bur oak (Quercus macrocarpa)	19	0.39	1.15	0.71
Swamp white oak (Quercus bicolor)	5	0.27	0.18	0.58
Chestnut oak (Quercus prinus)	6	0.33	1.94	0.77
Dwarf chinquapin oak (Quercus prinoides)	11	0.43	1.62	1.14
Red oak (Quercus rubra)	18	0.11	0.47	0.26
Yellow oak (Quercus tinctoria)	11	0.11	0.65	0.28
Spanish oak (Quercus falcata)	6	0.15	0.30	0.25
Beech (Fagus ferruginea)	8	0.34	0.75	0.51
Ironwood (Ostrya virginiana)	5	0.36	0.60	0.50
(Carpinus caroliniana)	6	0.56	1.34	0.83
Paper birch (Betula papyrifera)	9	0.20	0.31	0.25
Yellow birch (Betula lutea)	7	0.20	0.60	0.31
River birch (Betula nigra)	5	0.29	0.42	0.35
Aspen (Populus tremuloides)	5	0.31	0.76	0.55
Cottonwood (Populus deltoides)	6	0.65	1.39	0.96
CONIFERAE:				
Arborvitae (Thuga occidentalis)	9	0.27	0.50	0.37
Red juniper (Juniperus virginiana)	7	0.09	0.16	0.13
Bald cypress (Taxodium distichum)	12	0.32	0.59	0.42
Redwood (Sequoia sempervirens)	8	0.09	0.18	0.14
White pine (Pinus strobus)	10	0.12	0.26	0.19
Single leaf pine (Pinus monophylla)	5	0.41	0.83	0.68
Red pine (Pinus resinosa)	8	0.20	0.37	0.27
Western yellow pine (Pinus ponderosa)	11	0.23	0.49	0.35
Shortleaf pine (Pinus)	5	0.20	0.37	0.29
Longleaf pine (Pinus palustris)	15	0.16	0.32	0.25
Black spruce (Picea nigra)	6	0.20	0.33	0.27
White spruce (Picea alba)	5	0.24	0.40	0.32
Engelman white spruce (Picea engelmanni)	5	0.27	0.35	0.32
Carolina hemlock (Tsuga caroliniana)	11	0.25	0.70	0.46
Douglas fir (Pseudotsuga)	21	0.02	0.18	0.08

pure ashes as a basis for the calculations above. Wood as it is burned in commercial practice is never free from dirt, such as sand, which, although there may be very little in proportion to the weight of the wood, may and often does exceed the weight of the ashes obtained from the wood. Bits of charcoal and even sawdust are normal impurities in ashes.

In making an estimate of the amount of commercial wood ashes suitable for the manufacture of potash or to be used as fertilizer, it is believed that the ashes obtained from softwoods may be left out of consideration altogether. An attempt was made to collect information from the mills of the country cutting over 30,000 ft. b.m. of hardwood. This resulted in only partial success. Most of the mills apparently had no idea of the amount of ashes produced in their operation. Only in the States of Michigan and Wisconsin were the returns at all reliable. In these two States the mills for the most part were already selling their ashes, which probably accounts for their knowledge of the amount produced. It is believed, therefore, that an estimate based on the lumber-cut of hardwoods in the various States and the amount of ashes collected in Michigan and Wisconsin would be a conservative estimate of the easily collectible ashes, and would, if anything, be too small rather than too great, since the figures would not include the small mills or the small amount of softwood ashes and house ashes which is being used at the present time. Table IV gives such an estimate based on the yearly production of hardwood by States and the available ashes in Michigan.

These ashes are commercial wood ashes and contain, besides the pure ash, sand, cinders, charcoal, and probably sawdust. Some idea of the probable potash content can be obtained from Tables V, VI and VII.

Table V shows the variation in potash content in various species of wood. Table VI shows the variation in potash content of wood ashes produced by different industries. Table VII is a summary of all the wood ashes analyzed by the experiment stations of Massachusetts, New York and Connecticut, for the periods named.

TABLE II. ANALYSES OF WOOD ASHES

Species	Ash Content of Dry Wood, Per Cent	Potash in Ash (K_2O), Per Cent
Hardwoods		
Hickory	0.81	18.93
Red oak	0.94	16.41
White oak	0.41	29.90
Post oak	1.21	15.46
Dogwood	1.05	20.03
Ash	0.47	34.74
Chestnut	0.20	13.33
Sycamore	1.10	18.24
Magnolia	0.67	19.54
Average for hardwoods	0.76	20.28
Softwoods		
Pinus palustris	0.54	15.35
Pinus mitis	0.38	12.97
Picea nigra	0.32	10.43
Average for softwoods	0.41	12.91

TABLE III. TOTAL PRODUCTION OBTAINED BY THE BURNING OF ALL THE WASTE AND FIRE WOOD USED ANNUALLY

	Hardwood Tons K_2O	Softwood Tons K_2O
Waste	3,485	5,260
Firewood	102,240	33,228
Total	105,725	38,488
Grand total	144,210 tons K_2O	

TABLE IV. ESTIMATED YEARLY PRODUCTION OF AVAILABLE HARDWOOD ASHES

State	Production of Hardwood Lumber, 1915, Feet b.m.	Ashes Available Yearly, Estimated on Basis of Michigan Output, Tons
West Virginia	697,000,000	6,800
Michigan	550,000,000	6,000
Arkansas	464,000,000	5,100
Wisconsin	432,000,000	4,700
Tennessee	390,000,000	4,300
Kentucky	360,000,000	3,900
Pennsylvania	316,000,000	3,500
Virginia	292,000,000	3,200
Mississippi	276,000,000	3,000
Ohio	278,000,000	3,100
North Carolina	227,000,000	2,400
Louisiana	227,000,000	2,400
Indiana	198,000,000	2,200
Missouri	179,000,000	2,000
New York	173,000,000	1,900
Vermont	75,000,000	800
Texas	60,000,000	700
South Carolina	50,000,000	500
Maryland	53,000,000	600
Maine	50,000,000	500
		57,600

TABLE V. VARIATION IN POTASH CONTENT OF COMMERCIAL ASHES FROM VARIOUS SPECIES

Species		Where Burned	State Producing	Analyses of Ash: Water Per Cent	Insol. or Sand Per Cent	Sol. Potash Per Cent. K_2O	Total Potash Per Cent. K_2O	Phosphoric Acid P_2O_5 Per Cent.
Birch	(3)	.....	Maine	3.3	.....	5.24	7.27	3.00
Birch	(4)	Mill ash	Conn.	16.65	.....	3.88	....	2.05
Birch	(4)	Mill ash	Conn.	.....	.....	3.62	....	5.76
Birch Gray	(5)	Household	Conn.	.....	16.9	8.15	....	2.3
Birch Black	(6)	Boiler	Conn.	23.2	16.0	2.79	....	3.3
Birch Black Extracted		Boiler	Conn.	1.3	21.1	2.61	....	1.5
Chestnut	(5)	Household	Conn.	.....	8.1	3.96	....	1.69
Hickory	(5)	Household	Conn.	.....	4.6	7.54	....	2.19
Hickory	(7)	.....	.....	.....	.....	5.87	....	.....
Magnolia	(8)	.....	Mass.	1.58	.....	2.56	....	.95
Oak	(9)	.....	S. C.	.....	.....	4.75	....	2.40
Oak	(5)	Household	Conn.	.....	19.6	9.26	....	1.92
Peach trimmings	(8)	.....	Mass.	.54	.....	4.92	....	2.44
Pine	(3)	Refuse burner	Maine	.....	.....	0.40	1.53	0.66
Pine	(8)	.....	.....	2.76	37.46	4.37	....	3.07
Pine Hard	(8)	.....	.....	0.75	.....	10.16	....	2.04
Spruce	(3)	Refuse burner	Maine	20.6	.....	2.38	3.02	0.64
Spruce	(3)	Refuse burner	Maine	3.8	.....	1.35	2.62	1.52
Spruce	(3)	Refuse burner	Maine	.....	.....	1.90	3.06	1.58
Spruce	(3)	Boiler	Maine	.....	.....	0.88	1.93	1.27
Spruce	(3)	Boiler	Maine	0.88	.....	3.50	5.20	1.47
Spruce Sawdust	(3)	Boiler	Maine	1.19	.....	3.40	4.39	1.40
Walnut	(10)	.....	.....	3.79	2.29	5.06	....	2.06
Witch hazel	(11)	.....	.....	.....	6.65	5.23	....	2.75

TABLE VI. ANALYSES OF WOOD ASHES BY INDUSTRIES

Kind of Ash		State	Date	No. Analyses	Potash Content: Maximum Per Cent K_2O	Minimum Per Cent K_2O	Average Per Cent K_2O
Household (Hardwood)	(3)	Maine	1886	1	....	....	8.46
Household (Softwood)	(3)	Maine	1886	1	....	....	2.64
Household	(12)	Conn.	.....	1	....	....	6.73
Mill ashes	(4)	Mass.	1868–1896	14	8.8	1.2	4.17
Sawmill	(13)	N. Y.	.....	1	....	....	3.17
Factory (Hardwood)	(3)	Maine	1886	..	....	....	12.04
Foundry	(12)	Conn.	1906–1915	4	5.93	3.62	4.53
Lime Kilns	(13)	Mass.	1868–1896	17	2.78	0.02	1.09
Lime Kilns	(12)	Conn.	1906–1915	4	4.37	0.86	1.99
Lime Kilns		Vermont	.....	1	....	....	1.53
Brick Kilns	(12)	Conn.	1906–1915	3	2.16	1.16	1.54

TABLE VII. ANALYSES OF WOOD ASHES

Where Analyzed	Date	No. Analyses	Potash Content: Maximum Per Cent K_2O	Minimum Per Cent K_2O	Average Per Cent K_2O
Massachusetts	1868–1896 (14)	555	13.58	1.12	5.42
New York	1882–1907 (15)	65	10.00	1.10	4.50
Connecticut	1906–1915 (12)	111	7.46	0.23	3.62

Attention is called to the fact that in Table VII the more recent figures show a smaller average potash content than the older ones, and in several places in literature mention is made of the fact that the ashes are becoming poorer and poorer in potash. This may be due to the inclusion of a few samples of leached wood ashes, to changes in species burned, and to changes in the method of burning. The figures obtained for Connecti-

cut are probably more nearly correct for present-day practice than the others, and at any rate are conservative.

If the Connecticut figures are used as a basis, the total estimated production of potash from easily collectible wood ashes and hardwood sawmills is 2,100 tons, distributed as indicated in Table VIII. To this should be added the ashes which may be collected from softwood and the ashes collected from householders.

TABLE VIII. ESTIMATED POSSIBLE PRODUCTION OF POTASH FROM HARDWOOD ASHES BY STATES

State	Amount Tons	State	Amount Tons
West Virginia	245	North Carolina	85
Michigan	215	Louisiana	85
Arkansas	185	Indiana	80
Wisconsin	170	Missouri	70
Tennessee	155	New York	70
Kentucky	140	Virginia	115
Pennsylvania	125	Texas	25
Vermont	30	Mississippi	110
Ohio	110	South Carolina	20
Maine	20	Maryland	20

The Manufacture of Crude Potash From Wood Ashes

The production of potash from wood ashes is confined chiefly to the States of Wisconsin and Michigan. There is some production in Indiana, Maine and Ohio, but it is an extremely small proportion of the total.

FIG. 1 TYPICAL EXTERIOR VIEW OF MODERN POTASH PLANT

There are only four factories in these three States; in Michigan there are twenty-six and in Wisconsin twenty-five.

Method of Production

The general method of production of crude potash from wood ashes is the same as that followed generations ago. It consists simply in leaching the wood ashes with water and evaporating the weak lye thus obtained. Apparently very little advance has been made in the art, the whole operation being carried on chiefly by rule of thumb methods. A number of potash plants have been built during the last year or so, of which Fig. 1 is a typical exterior view. The apparatus generally used in Michigan and Wisconsin consists of a battery of from 18 to 24 leachers, or, as they are termed in the trade, ditches, an evaporator, or pan, and from one to two pots or kettles for the fusion of the material.

The leachers are merely vats provided with false bottoms, over which is laid a layer of straw, this in turn usually cemented in place with a quicklime paste. This straw and lime paste are rarely removed oftener than once in six months, and act merely as a filter. The leachers themselves, in cross-section, may be either round or rectangular. If round, they are usually about 5 ft. in diameter and 5 ft. high. If rectangular, they may be 5 ft. each way; occasionally they are made 4 x 6 ft. and 5 ft. high. Such a vat will hold between 1½ and 2 tons of dry ashes. The bottom of the leachers are tapped with holes approximately 1 in. in diameter, through which the weak lye trickles into a trough made of galvanized or black iron very similar to that commonly known as the eaves trough in house construction. Figs. 2 and 3 are illustrations of a typical leaching battery. The leachers are raised, so that the trough at the bottom is inclined toward the evaporating pan. This is usually done by setting the leaching apparatus on piles from 4 to 6 ft. high.

The evaporating pan is a rectangular wrought iron pan, approximately 4 ft. wide and 9 ft. long by from 1½ to 2 ft. deep. This is sometimes corrugated, but the usual type of present-day pan has a flat bottom. It is set in brick work and is heated by a direct flame below. Usually a separate fire box is built for the pan, but in some cases the weak lye is evaporated to concentrated lye by the waste heat of the fire from the kettles. This is particularly the case when more than one kettle is used in one plant.

The kettles are cast iron, hemispherical receptacles approximately 4 ft. in diameter, with a slight flange at the top. They are set in brick work, sometimes with a flange 2 or 3 in. above the bricks. In a number of places a boiler plate flange 2 ft. high and about 5 ft. at the top and 4 ft. at the bottom is fastened to the top of the kettle to prevent it from boiling over during he operation of "melting."

The only equipment, in addition to these three main pieces of apparatus, required in the operation of a potash plant are the necessary ladles for dipping the concentrated lye from the pan to the kettle, scales for weighing the potash, some sort of iron receptacle for cooling the molten mass, particularly if iron drums are not used in the shipment of the material, and a good

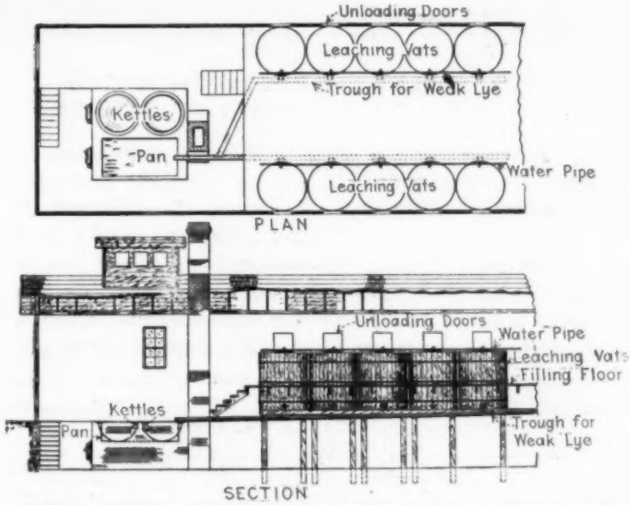


FIG. 2 AND 3. PLAN AND SECTION OF A WOODASH EXTRATION PLANT

Baumé hydrometer. Some plants have a gasoline engine attached to a pump for water supply. Some, more conveniently located, have their water supply piped to each vat. Some wet down their leachers by the use of a pail. Figs. 2 and 3 are plan and section of a typical potash plant.

The ashes collected are shoveled into the leaching

vats. Particular care is exercised to have them thoroughly tamped in the course of filling. This is sometimes done with an ordinary tamper and frequently by tramping, the latter method being used particularly by old potash makers.

The method of leaching varies to some extent, but in general that used in the greatest number of potash plants in Wisconsin and Michigan is as follows: The leachers are wet three times a day with approximately 10 gal. of water at each wetting. At the end of the third or fourth day, depending somewhat on the dryness of the ashes, the lye makes its appearance at the bottom

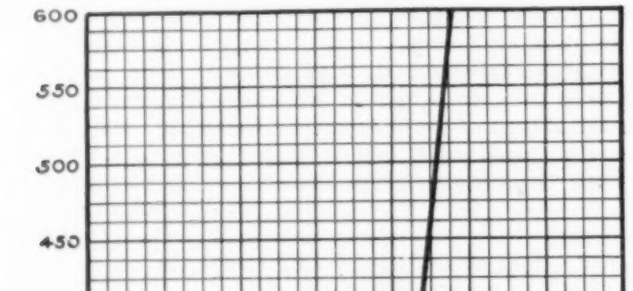


FIG. 4. BOILING POINT-CONCENTRATION CURVE

of the leach. A sample of it is caught, usually every morning, and tested for its density (specific gravity) with a Baumé hydrometer. Leaching is continued in most cases until the lye indicates 2 Baumé. When this point is reached the vat is discontinued and a new charge put in. Table XII shows the time required for the leacher to start running and the approximate strength of lye with each day's leaching. The figures given are

TABLE IX. APPROXIMATE DECREASE IN STRENGTH (DEG BAUME) OF LYE AS LEACHING PROCEEDS.

At the Start	Time, in Days, After Filling							
	3	4	5	6	7	8	9	10	11
8	8	5	3	2	..	..	..	..	..
10	..	10	8	5	3	2	..	..	..
12	..	..	12	8	5	3	2	..	..
14	..	..	14	10	7	5	3	2	..
16	..	..	16	11	7	5	3	2	..
18	..	..	18	13	9	6	3	2	..
20	..	..	..	20	14	10	7	5	2
22	..	..	..	22	15	11	7	5	2

averages, so that individual cases may vary somewhat from those given in the table. The average initial strength is approximately 16 Baumé with the method of operation just described, the maximum running from about 25 to as low as 7 in isolated cases.

Table X shows the strength of a solution of crude potash using different Baumé degree readings. No attempt is made in practice to separate the strong from the weak lyes. All of them are sent to the evaporating pan, where they are evaporated to approximately 20 deg. Baumé.

TABLE X. RELATION BETWEEN DEGREES BAUME AND AMOUNT OF DISSOLVED POTASH

Deg. Baumé	Per Cent Potassium Carbonate in Solution	Deg. Baumé	Per Cent Potassium Carbonate in Solution
0	0.6	12	9.6
2	1.6	14	11.3
3	2.3	16	13.1
4	3.0	18	15.0
5	3.9	20	16.8
6	4.6	22	18.7
7	5.5	24	20.6
8	6.3	26	22.3
9	7.2	28	24.2
10	8.0	30	26.2
11	8.8	32	28.3

The lye as it goes to the evaporating pan is usually a clear, pale, straw-colored liquid, but on evaporation the liquor becomes darker and darker, until it is a deep chocolate brown when it reaches the melting kettle. Frequently during the operation sludge (or "salts") settles, and this for the most part is composed of impurities which are soluble in the weak lye but insoluble in the more concentrated material and potassium sulphate. From the evaporating pan the strong lye is ladled over to the melting kettles, where the evaporation is carried on further. The temperature of the boiling liquor gradually rises, probably according to the curve in Fig. 4. No line of demarkation can be noticed between the point where all of the moisture disappears and the point at which fusion takes place, except that as the temperature rises the lye froths more and more until finally a maximum is reached, after which the frothing gradually subsides, leaving molten potash. This is then ladled from the kettle into cooling pans or iron drums, and is ready for shipment as crude potash.

This crude potash, or "first sorts," may vary somewhat in composition, but is in general a mixture of caustic potash, potassium carbonate, potassium sulphate, potassium chloride and insoluble matter. The following is given by Edgar as an analysis of "first sorts."

	Per Cent
Potassium hydroxide	65.64
Potassium carbonate	16.58
Potassium sulphate	16.03
Potassium chloride	0.35
Moisture and insoluble	1.40

COST OF MANUFACTURE

The cost of apparatus and installation varies of course with the local cost of lumber, brick work, plumbing, labor, etc., also according to whether or not a new building must be erected to house the plant. The following is an estimate of cost in 1917 in Wisconsin:

Building	$2000 to $2500
24 leachers at $20	480
1 evaporating pan	200
2 kettles at $60	120
Masonry, fire boxes, etc., with chimney	500
Plumbing	100
	$3400 to $3900

Any estimate of the cost of manufacture of potash is dependent almost entirely on the cost of labor, fuel and ashes. In Wisconsin and Michigan the potash maker or boss of the plant receives in the neighborhood of $4 per day; laborers, about $2.50; a man with team, $6.

The following estimate of cost manufacture is based on a 24-leach plant running at full capacity, with an average of 10 days total time per leach and obtaining

125 lb. of crude potash from each leach, making a total of 90,000 lb. per year:

Depreciation at 33⅓ per cent	$1300
Interest on investment at 6 per cent	120
Labor cost—Potash maker at $4	1200
2 laborers at $2.50	1500
1 man and team at $6	1800
Fuel—180 tons at $7	1260
Repairs of kettles	120
Water	70
Electric light	30
Barrels—130 at $1	130
Total yearly expense	$7530

Manufacturing cost per lb. of crude potash, 8.3c.

The same plant, however, if running at half capacity, would have the following costs:

Depreciation at 33⅓ per cent	$1300
Interest at 6 per cent	120
Labor cost—Potash maker at $4	1200
1 laborer at $2.50	750
1 man and team at $6	1800
Fuel—90 tons coal at $7	630
Repairs on kettles	60
Water	35
Electric light	30
Barrels—65 at $1	65
Total yearly expense	$6190

Manufacturing cost per lb. of crude potash, 13.7c.

The cost of manufacture per pound is also dependent very largely on the amount of potash in the wood ashes. Table IX shows that if the lye starts to run at 22 Baumé, it will take 11 days for the leaching to be finished, but if the lye starts to run at 18 and 8 Baumé, it will take 10 and 7 days, respectively, to finish. The yields of crude potash in these three cases are as follows:

No.	Degrees Baumé	Days to Finish	Yields Crude Potash, lb.
1	22	11	152
2	18	10	106
3	8	7	44

A plant obtaining ashes such as No. 3 will cost practically as much to run as that obtaining No. 1; and there will be more work attached to the operation, since No. 1 will have to be filled only 27 times a year as against 43 times for No. 3. The cost of manufacturing 1 lb. of potash in each of these cases would be as follows: No. 1, 7.6c; No. 2, 9.9c; No. 3, 16.7c.

No attempt has been made to determine before purchase how much crude potash can be obtained from ashes and it sometimes happens that ashes are used which are so lean in potash as to result in a loss. Some simple method of estimation is needed whereby both the consumer and producer can tell with reasonable accuracy the amount of potash which can be obtained from a ton of ashes. The following method is suggested as giving a fair idea of the amount of potash obtainable: Place a 1-lb. sample of wood ashes with 1 qt. of warm water in a 2 qt. Mason jar. Screw the cover on tightly and shake the jar vigorously every two minutes for one-half hour. Allow the ashes to settle and filter the liquid layer through fine cheesecloth or, better still, filter paper. Test a sample of this liquor with a Baumé hydrometer. Refer to tables and multiply the amount of potash thus obtained by 2. This gives the percentage of crude potash by weight.

Conclusions

The following conclusions can be drawn from the paper:

The ash content of hardwoods according to the tables given ranges from 0.05 to 3.02 per cent, with an average of 0.61 per cent. The ash content of the coniferæ seems to vary from 0.02 to 0.82 per cent, with an average of 0.30 per cent. There may, however, be very wide variations in the ash content of the same species. This is instanced by black walnut, with a minimum ash content of 0.21 per cent, a maximum of 1.96 per cent, and an average of 0.79 per cent, or chestnut oak, whose minimum, maximum and average ash contents are respectively 0.33, 1.96 and 0.77 per cent.

The potash content of pure, well-burnt ashes may be very high, ranging from 10 up to 35 per cent. These figures are, however, of but little commercial value, since all commercial ashes contain impurities, such as sand, sawdust or charcoal, and these impurities may make up a very large per cent of the total ash.

The potash content of commercial wood ashes may vary over a comparatively wide range, depending somewhat on the wood used and the kind of furnace or stove in which produced. The average of 112 analyses made in Connecticut from 1906 to 1915 was 3.6 per cent K_2O.

The initial cost of a potash plant of 24 leachers is between $3000 and $4000, provided a building has to be erected for that purpose.

The cost of manufacture of potash, not including the cost of the wood ashes, will vary from about 7c. to 17c. a lb., depending upon the kind of ashes obtained and whether or not the plant is running at full capacity. From this it is evident that the manufacture of potash from wood ashes will not be a paying proposition when normal prices are resumed, except in those cases where the plant has already been paid for and is owned by the potash maker who makes no charge for his own labor, but accepts his profits as compensation for his work. Under these conditions the cost of manufacture of potash, exclusive of the cost of ashes, may be reduced to about 5c. a lb. and might be able to compete with imported potash on a small scale under normal conditions.

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Wealth of Ardlethan (New South Wales) Tin Mines

The New South Wales Government geologist recently visited the Ardlethan tin field and inspected the principal mines, including the Carpathia, White Crystal, New Venture, and Big and Little Bygoo. He expressed himself as impressed with the potential wealth of the field. In his opinion the time is not far distant when the ore deposits in these mines will be extracted in bulk and sent to the batteries, as much of the country contains payable tin which is now lost or overlooked. The geologist stated in his report that the Ardlethan field may be regarded as a valuable national asset.

Some Factors Involved in Drying Operations

AT THE April meeting of the Chemical Engineering Group of the Society of Chemical Industry at London, Mr. Eustace A. Alliott gave an important contribution' on drying, from which the following is an extract:

In considering a drying problem, a most important factor—in addition to the quantity to be dealt with and the total amount of moisture to be removed—is the nature of the final dryness required. In connection with this matter "bone dryness" is often referred to, but as this term may cover quite a wide range of moisture percentage, even in regard to the same material, it is not sufficiently explicit. In case of a material such as ammonium perchlorate it may mean 0.25 per cent of moisture, and in the case of organic manures it may be in the neighborhood of 10 or 12 per cent. Further, one user

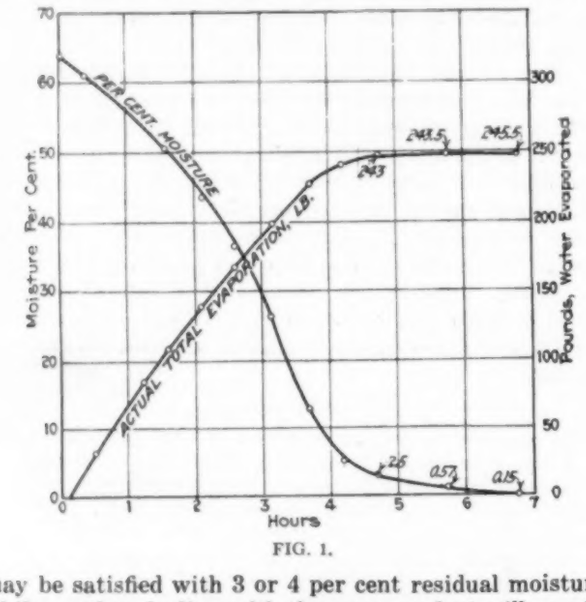


FIG. 1.

may be satisfied with 3 or 4 per cent residual moisture, while another dealing with the same product will require say ½ per cent. The importance of the influence of the final dryness, not only on the time factor but also on fuel economy, is perhaps not sufficiently realized.

The accompanying curves show the influence of both initial and final moisture on length of drying and other factors. They relate to an experiment carried out in a small jacketed pan, 4 ft. in diameter, of a type more particularly described later. This pan was provided with agitators, and worked under vacuum. The test was carried out by the author at the works of Manlove, Alliott & Co., Ltd., Nottingham, by whose special permission it is possible to give the following particulars. It may be said that while these figures refer to a particular drier, they also have an important bearing on results in other types. The curves in Fig. 1 show the amount of moisture in the material at every moment throughout the process, and also the amount evaporated. The particular material dealt with was prussian blue, and the figures all relate to a charge of 140 lb. of dry color. It will be noted that the moisture percentage falls fairly regularly to about 5 per cent, but that under 2½ per cent the time lengthens out very much. The rate of evaporation remains fairly steady to about 12½ per cent, when it falls off very rapidly.

J. Soc. Chem. Ind. 147T, vol. 38, No. 13: July 15, 1919.

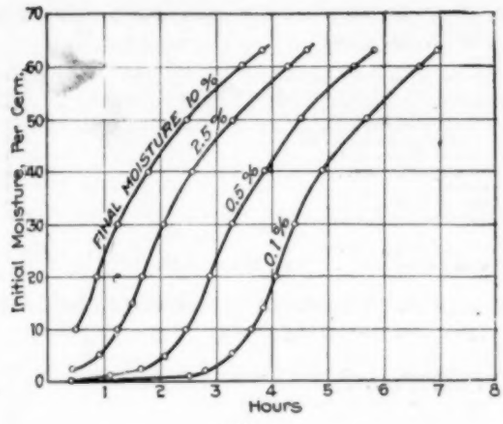


FIG. 2.

The curves in Fig. 2 indicate the length of the operation, including charging, heating up, and discharging the the material. This time varies very definitely with the moisture conditions. From 60 per cent to 0.1 per cent the time is 7¼ hr., from 60 per cent to 2.5 per cent 4.6 hr., but from 60 per cent to 10 per cent only 3.7 hr. From 30 per cent to 2½ per cent, 2¼ hr.; from 10 per cent to ½ per cent, nearly 2¾ hr., and from 2½ per cent to 0.1 per cent, 3¼ hr. It will thus be seen that the drying period may be distinctly longer, even with a much smaller amount of moisture to be removed, if the final moisture is decreased.

In Fig. 3, the four curves on the left show the average evaporation during the period the material in actually in the machine. From 60 per cent to 10 per cent it will be observed that the average rate is 58 lb. per hr. From 60 per cent to 0.1 per cent little more half, or 32 lb. per hr. From 2½ per cent to 0.1 per cent the rate is barely 1 lb. hourly. The discontinuous curve shows the instantaneous rate of evaporation. It will be seen from this that the momentary rate at which water comes away at any particular moisture content varies curiously. At 63 per cent the rate is about 90 lb. hourly; this falls rapidly with decreasing moisture to a little under 60 lb., where it remains constant for quite a wide range of moisture content. Below 12½ per cent it again falls rapidly to zero, though if this portion of the curve were drawn on a time basis it would be seen that from this point of view the fall is a slow one. In the case of certain other materials the three parts of the curve merge smoothly into one another.

Fig. 4 shows the average output reckoned in lb. per hr. throughout the whole operation, including allowances for charging and discharging. At 60 per cent initial

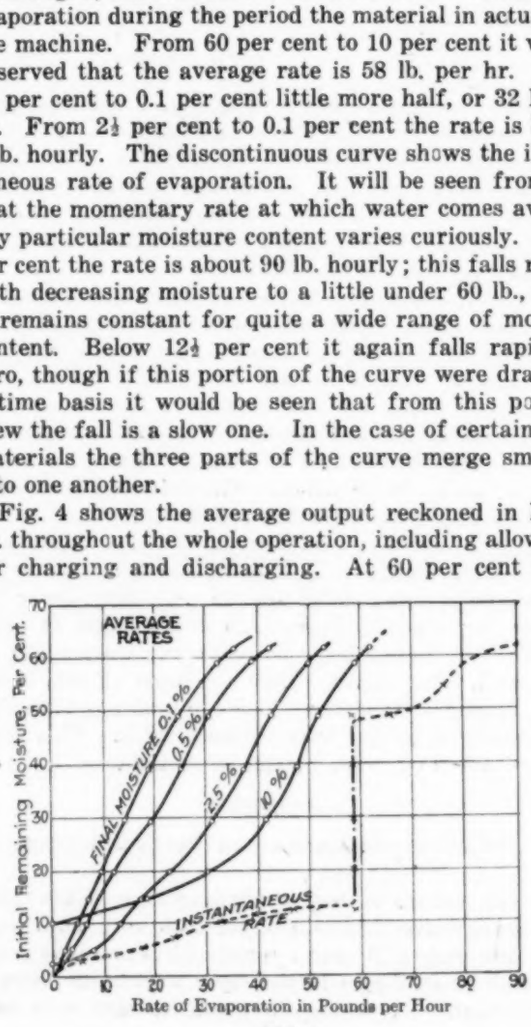


FIG. 3

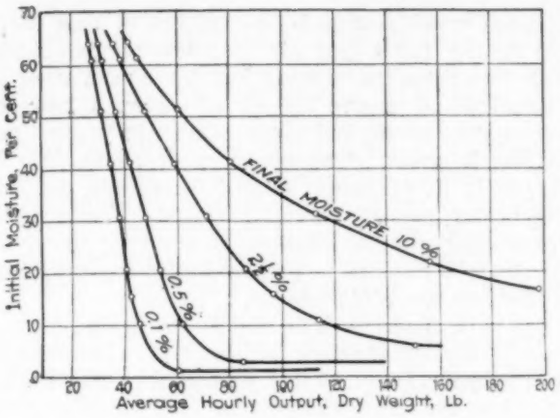


FIG. 4

moisture the outputs are 37 lb. per hr. for 10 per cent final moisture, and 20 lb. per hr. for 0.1 per cent. For 10 per cent to 2½ per cent the output is about 1 cwt.; these weights refer to the dry material absolutely free from moisture. For the lower moisture percentages better results would be shown if the charge were somewhat larger.

The steam consumption follows similar lines to the foregoing (see Fig. 5). It should be said that the test results were irregular, owing to condensed water draining in from the steam supply pipes. In getting out these figures, therefore, a suitable loss of heat has been assumed. This method of calculation is perhaps a little unfavorable in the case of very low moisture content, and the figures might also be expected to benefit at slightly heavier charges.

The curves for the final moistures of 10 per cent and 2½ per cent are almost identical from 63 per cent to 20 per cent initial moisture, and vary from 1.23 to 1.65 lb. of steam per lb. evaporated. The figures for the 10 per cent curve are of little interest below this point. The final moisture of 0.1 per cent has a steam consumption ranging between 1.4 lb. to 2.4 lb. for initial moistures between 60 per cent and 10 per cent. For 2½ per cent initial and 0.1 per cent final the figure is 13 lb.

Fig. 6 gives the amount of dried material per lb. of steam. This varies from roughly ½ lb. at 60 per cent initial with almost any final moisture, and 3.3 lb. for 2½ per cent initial to 0.1 per cent final moisture.

The chemical properties are mainly important as they influence the material of which the drier can be constructed. If iron or steel is out of the question, one is largely limited to stationary types, as, generally speaking, agitated driers of other materials are either very expensive or are subject to very great difficulties of construction or reduction in the efficiency of the drier.

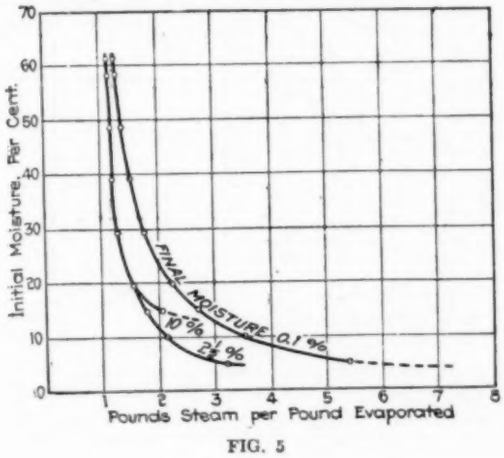


FIG. 5

Of materials other than iron and steel, copper is perhaps the most used for pans or rollers, but it wears rapidly if scraped closely. Wood is a very useful material where hot air is the drying agent, and is employed with advantage for rotating cylinders. Lead or enamel is possible where the agitation is of a light nature and the agitators do not press on the lined surface. Enamel of course is a distinct hindrance to the efficient conduction of heat.

The temperature-sensitiveness of the material to be dried affects design, output and economy in an important measure. Generally speaking, low temperature means low economies, especially in hot-air drying. Materials sensitive to heat may be dealt with in vacuum or by hot air, or, in suitable cases, by film-drying or sprays. In the latter instance the time of drying may be exceedingly short and the average temperature also low.

The specific heat has little influence except at low initial moisture content or high final temperatures. The conductivity and the diffusion factor have undoubtedly

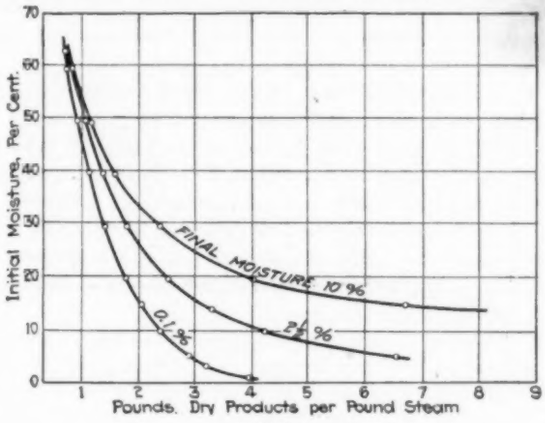


FIG. 6

an appreciable influence, especially when the amount of surface moisture is small and the material is in masses. The exact importance of this influence, is, however, difficult to determine.

Methods of Heating

Methods of heating include furnace or direct heat, steam, hot water, and warm air.

In furnace-heated plants the economy is strictly dependent on the method of application. Control is a very important factor, but economy is also dependent on a high average initial temperature, with a low ultimate temperature for the used products of combustion. Batch machines are not economical when heated by direct furnace. In the case of a single machine the gases cannot be cooled sufficiently before they pass away to the flue, while if several machines are placed in a row the result is cumbersome brickwork, and varying conditions from machine to machine. It should be remembered that, in comparison with steam, gases are poor transferrers of heat, and their efficiency is dependent upon high temperature and intimate contact with the cool material. The most suitable plant for utilizing furnace heat is the rotary continuous drier, which has the advantage of both high output and good economy.

The evaporation per lb. of fuel varies enormously with the conditions. In an ordinary efficient plant,

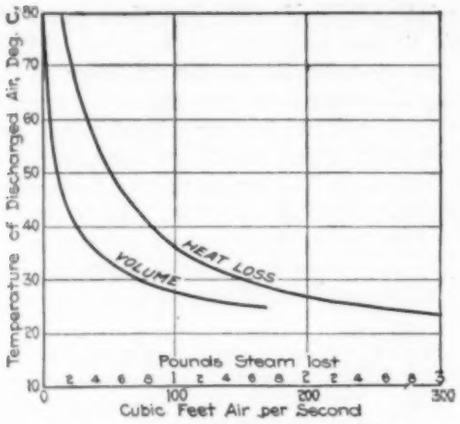


FIG. 7. PROPERTIES OF AIR
Assumptions—Air initially saturated at 10 deg. C. discharged half saturated

with medium conditions regarding materials and no very special supervision, 5 lb. of evaporation per lb. of fuel would be obtained, while under the best circumstances 10 lb. or more may be attained. In regard to fuels, coke is superior to coal where the products of combustion come into direct contact with the materials, while gas gives ease in control and requires little supervision.

Direct steam if economically raised and used may almost vie with direct-fire heat as regards economy. If it is assumed that 1 lb. of coal at the boilers will produce 6 lb. of steam at the drier, from 3 to 5 lb. of evaporation may be expected per lb. of coal at ordinary figures, though these may be less or more in extreme cases. Steam is a most efficient agent for batch drying, although it is applied with advantage to some continuous driers with equal results.

Superheated steam is, generally speaking, a delusion as a source of heat for drying. As it is a gas, its capacity for transferring heat is poor, and the capacity of a plant is liable to be much diminished by its use, which is only justified for very special requirements. Dry steam is all to the good, as there is less water to drain away from the heating surface. Hot water has to be used sometimes in order to dry delicate materials at low temperatures, but in this case again a great reduction of capacity may be expected. Steam at less than atmospheric pressure would be preferable to hot water in some ways, but it is not quite so easily applied and controlled.

Hot air has the great advantage that it can be brought into very intimate contact with suitable agitated and divided material, and thus large outputs may be obtained even at low temperatures. In certain cases its use, especially at low temperatures and high saturations, imparts a quality and texture to the product otherwise unobtainable. The air may be heated by a furnace-fired heater, but saturated steam is generally employed for this purpose. Under certain circumstances, where temperatures of 500-600 deg. F. are requisite, a gas-fired heater may be employed with advantage.

The economy is decidedly less than with fire-heated machines, owing to the lower initial temperature and output, especially with materials containing any appreciable amount of water. One lb. of coal under the boilers may evaporate 1.2 to 2 lb. of water in the driers, the air being heated to 80 or 90 deg. C. Under the best conditions one might possibly get 3 lb.

A great consideration is the amount of heat carried away by the discharged air. At low temperatures it will be seen from the curve in Fig. 7 that the amount of air required to remove 100 lb. of water, if half saturated, is very great; and consequently the proportion of heat lost is great. The upper curve shows this loss reckoned in lb. of steam, at 60 lb. pressure, condensed in the heater, per lb. of water removed. If this temperature of discharge can be raised in any way, the amount of air may be reduced in greatly increasing proportion, and this loss much diminished.

Now, with losses, such as that in the heated material, equalling the expenditure of heat in evaporation, an initial temperature of 90 deg. is needed to give the heat required to evaporate the amount of water the air will carry at 35 deg. C.; while initial temperatures of 800 to 1000 deg. C. or more are needed if the discharge temperature is 70 deg. C. or over. To enable similar economies to be obtained with lower initial temperatures, the air may be brought out of the drier at a higher final temperature than would be economical under ordinary conditions, and a portion of warm moist air is taken back to the heater and through the drying chamber, re-utilizing the heat, and attaining the required degree of saturation, so that the whole of teh evaporation is carried away in the discharged portion.

The value of this device increases when the normal discharge temperature is low, for, as will be seen from the curve, a small increase in temperature means a large corresponding decrease in the loss of heat. It is also much affected by the temperature and saturation of the atmosphere at any given time; by the degree of moisture in the product being treated, and the readiness with which this is given up.

The curves in Fig. 8 represent, for a given initial temperature of 90 deg. C., the final temperature attained with various degrees of recirculation, together with the volume of air which passes through the drier to evaporate 100 lb. of water.

These curves illustrate the general tendency, but it should be observed that these are necessarily drawn on certain fixed assumptions. In practice it is necessary to exercise much judgment as to saturation percentages, etc., obtainable in each case.

The uses of vacuum are to increase the capacity per square foot of heating surface; to allow the use of ex-

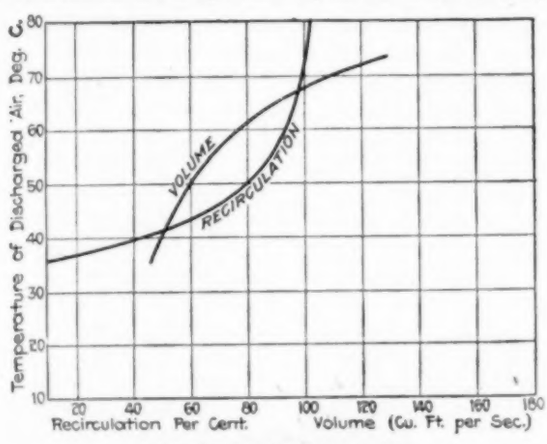


FIG. 8. RECIRCULATION
Relation of discharge temperature to percentage of air recirculated and cu.ft. of air sec. passed through drier to evaporate 100 lb. per hour.
Assumptions—Air discharged 50 per cent saturated; outside air saturated at 10 deg. C. Radiation losses plus heat given to material equal heat for evaporation.

haust or low-temperature steam, if available; to shorten the period of drying and exposure of material to heat, and to reduce the average temperature of the material during drying. It is of special value where the last traces of moisture are to be removed.

There is little or no direct economy of fuel when vacuum is used. There is a certain reduction of heat losses and power, due to lower temperatures and accelerated drying, but these at times will be largely counterbalanced by the power used for the pump. It is too readily assumed that the temperature in a vacuum drier is the boiling point of water under the vacuum used. It may approximate very closely to this, so long as the moisture is evaporating freely, but as the water loses its mechanical freedom the temperature will rise. When the moisture is entirely in the pores of the material, especially if this be of a close texture, or the material is in masses or balls, the temperature will rise approximately to that of the heating medium, as a rule, soon after the moisture has been reduced to 5 per cent.

The output per square foot of heating surface varies very much with conditions. For ordinary steam-heated, agitated driers, not under vacuum, the evaporation will be from 2 lb. to 3 lb. per sq.ft. for fairly moist materials, reduced to a point at which they are dry to touch and appearance; with only 3 per cent moisture reduced to under 0.5 per cent, and a badly conducting material, the evaporation might only be $\frac{1}{3}$ to $\frac{1}{2}$ lb. per sq.ft. per hour. With materials of a nature from which the water evaporates very freely, such figures may be exceeded under suitable conditions. On the other hand, even where a fairly thin layer of moist material is worked between two heated surfaces, an evaporation less than 1 lb. per sq.ft.-hr. may be obtained. If the material is in the form of a thin film, outputs of from 2 to 8 lb. without vacuum are recorded. With materials which were not specially favorable, in ordinary agitated vacuum driers, this latter would be an extremely high figure, though not unattainable on occasions. A more usual figure for most moist materials would be 4-6 lb.

Means of Agitation

The object of agitation is to bring fresh portions of material into contact with the heating surface, and to break it up and turn it over to permit the free escape of vapor, thus materially increasing output, especially in the case of very low moisture content. In some cases its use results in a very definite saving in fuel, as, for instance, in utilizing direct-fire heat to its best advantage. In other cases, the fuel consumption may be the same or greater, but there is a very definite saving in labor and increased output for space occupied. In considering any type of agitator it should be remembered that the properties of the material may be very different at various stages of the process. A not unusual sequence is a thin, almost liquid paste, passing through a heavy clayey stage to large masses, which break down into more or less fine granules, ending up in a dusty powder. Hence the best design of agitator is usually a compromise. Possibly the material may tend to roll into balls, and it is then largely a question of the relative conductivity, porosity and cohesion as to whether this will prevent further drying or whether the balls will dry satisfactorily with further agitation.

Materials which cling closely to hot surfaces demand powerful knives or plows. Some materials will tend to grow into a hard layer under such plows, unless, as is often arranged in film driers, the knife edge can be adjusted close to the surface at every point. An occasional remedy in such cases, where the rubbing action of the plow appears to lay the material on to the hot surface rather than to remove it, is to keep the scrapers or combs clear of the bottom, and follow up with hard-pointed chisels. In some cases it will be found that either no layer is formed, or that, if there is a layer, it will be comparatively soft, and will be effectively picked up and flaked off by the chisels as rapidly as it is formed. Rakes with staggered blades, arranged to push first in one direction and then in another, are very useful for materials which lack cohesion and which are not worked very deep.

Rotating cylinders fitted with lifting vanes are very effective agitators, especially for non-cohesive materials, when the vanes can be shaped to give an even curtain of falling material right across the machine. Balls or scrapers may be very useful adjuncts where the product tends to mass or build up on the shelves. Balls are very effective if they can be lifted and dropped, and if they are made with a hole through them they will have less tendency to collect a hard layer of dried product on their surface. They prevent material cohering in masses or adhering to the shell of the drier.

The speeds of agitators and revolving drums should, as a rule, be fairly low; too high speed absorbs power, may tend to cause the material to ball, and adds little, if anything, to the rate of drying.

In order to spread material in layers, it may be allowed to fall on to a traveling band passing over a hot surface. The most usual method is, however, to spread it or squeeze it on to rotating cylinders. The special advantage of this method is the shortness of the exposure to heat.

It is to be regretted that limitations imposed by the business policies of many of these concerns prevent the setting forth of interesting technical details. It is hoped, however, that the reader will get some idea of the number and magnitude of the problems of chemical industry that are being solved in this region. Great as the development has been, it is only a beginning. Unequalled transportation facilities, a plentiful supply of fuel, space for development without limit and a wonderful agricultural region to feed industrial populations are economic forces that are all working in favor of this district.

Belgian Commercial Museum Wants Samples

The commercial attaché of the American Embassy at Paris has received a request from Emile Jottrand, director of the Institut Commercial des Industriels du Hainaut, a high school of commerce and industry at 18 Place Warocqué, Mons, Belgium, for samples of American raw materials and graphic exhibits of manufacturing processes for use in its commercial museum. This institute formerly had an extensive exhibition, but the collections were ruined during the war. The director will be grateful to any American business concerns which care to send direct to him small samples, illustrations or catalogues that would be of interest in a practical commercial museum.

Electrically Heated Soaking Pits in the Steel Industry*

By Thaddeus F. Baily
President, the Electric Furnace Co., Alliance, Ohio

THE introduction of electrically heated furnaces to the heating operations subsequent to melting and refining in the steel industry has experienced the slow development incident to the introduction of all radical innovations in any industry. Many of the types that will find wide application in the future, while entirely feasible, have, when offered, been met with the statement that if such an equipment was a good thing, why were they not in general use. Other types, that have been in regular service for a considerable number of years, whose construction and operation are much more elaborate and whose commercial advantages are no greater, are now generally accepted as the most rugged and reliable equipment for the purpose. This latter refers to electric furnaces for the annealing and heat treatment of steel.

Cost Per Ton of Material Treated in Electric vs. Fuel-Fired Furnaces

The higher "fuel" cost for electric furnaces over fuel-fired furnaces that might have been used for the same purpose has been amply justified in commercial practice by the labor saving effected, the precision of the treatment produced, and the elimination of the rejections of parts due to defective heat treatment; the precision of the laboratory is obtained in regular plant practice.

There has been a reluctance of manufacturers generally to consider that there is a difference in cost per ton of material put through a furnace and the cost per ton of material heat treated and coming within the specifications. There has been no greater factor in changing this attitude than the conditions brought about during the war, where in a great many plants there was a wide difference between the quantity of material inspected and the quantity of material accepted. Manufacturers now are generally conceding the justness of the higher requirements for steel, and this is one of the greatest arguments in favor of electric furnaces.

Adaptability of Electric Furnace

Conspicuous examples of the electric furnace for heat treating are those for Liberty Motor crank shafts, over half of which were so heat treated; cast steel anchor chain, all of which was heat treated in furnaces of this character; and draw-bar knuckles, substantially half of those which are used in America being thus heat treated.

They are also adapted to other operations in the steel industry, and embrace soaking pits for the soaking of hot stripped ingots, re-heating furnaces for hot blooms and billets, combination fuel and electric furnaces for the heating of cold blooms and billets, recuperative car type annealing furnaces for bars and sheets, and automatic heat treating equipments for drop forgings and castings and for the heat treatment of steel rails and similar material.

The electric soaking pit for hot ingots is perhaps the most promising development of the electric furnace to the steel maker, as the shortcomings of the present pits—whether of the fired or non-fired type—are well known, and many troubles of the rolling mill can be traced to the present type of pit.

The principal recommendation of the present type of pits, either of the fired or non-fired type, is the low fuel consumption per ton of metal soaked. This cost in a well handled pit is almost a negligible item, amounting frequently to only a few cents a ton.

The Electric Soaking Pit

However, in the larger mills, when running at full capacity, features such as lack of uniformity in temperature of the heated ingot, excessive oxidation of the ingot, and the like, are often such as to quite outweigh the item of mere fuel cost; and while it is to be admitted that electric pits cannot compete with fuel-fired pits under ordinary circumstances, when heating cold ingots, the time is not far distant when substantially all modern mills rolling hot ingots will use electric pits for this part of steel mill operation.

It has been difficult to overcome the prejudices against this innovation in ingot soaking; but the advantages to be gained are so apparent, and the success of electric furnaces in other similar fields has been so marked, that it will not be long until electric soaking pits will be in commercial operation.

It is to be expected that the cost for heat with an electric pit may be in excess of similar costs for gas-fired pits or unheated pits; but when taking into consideration that the electric pit will eliminate the roll breakages due to cold ingots, delays in the mill due to ingots unevenly heated, oxidation (thus producing a cleaner bloom and an actual saving in metal due to this elimination of oxidation, amounting to perhaps one-half of 1 per cent), as well as the ability of the electric pit to save labor, it is certain that the higher cost will be more than offset by the advantages, and that per ton of metal rolled in a given period the actual cost by the use of an electric pit will be less than by other means.

Fig. 1 shows the general arrangement and character of such a pit. This pit is provided with eight holes, instead of the usual four, and in consequence only half as many ingots will be located in each cell.

The resistance elements themselves, composed, as in all furnaces of this class, of broken carbon thrown loosely into a carborundum fire-sand trough supported on brick pillars, are located along the outer wall of each side of the pit, and protected against the liability of serious accident from the ingot by being recessed some distance back from the ingot cell itself. The heat from this resistance element, it will be noted, is radiated to the circular wall of the pit, and thence to the cover, the partition wall of the pit, and to the ingots themselves. The cross-section of this resistor element is such that there is very little difference between its temperature and the ruling temperature of the pit; and in actual practice most of the heating is done by the walls of the pit itself, rather than by direct radiation from the resistor element—this being of the highest importance in obtaining uniformity of heating.

In cases where the ingots cannot be delivered to the pit with enough heat for them to reach a high enough temperature without the addition of more heat from the pit itself, a longer time will be required by the ingots to

*Extract of a paper read at the fifteenth general meeting of the American Iron and Steel Institute, New York, May 23, 1919.

bring them to temperature, and at the same time the capacity of the pit in tons per hour will be reduced.

Taking as a basis ingots whose average temperature would be 1800 deg. F., requiring 300 deg. additional for bringing them to temperature, the capacity of the pit would be reduced to 24 tons per hr., the electrical capacity of the pit increased to 1500 kw., and the current consumption increased to 60 kw.-hr. per ton.

With the ingots charged at an average temperature of 1500 deg. F., the capacity of the pit would be reduced to 16 tons per hour, and the current consumption increased to 90 kw.-hr., without increasing the electrical capacity beyond 1500 kw.

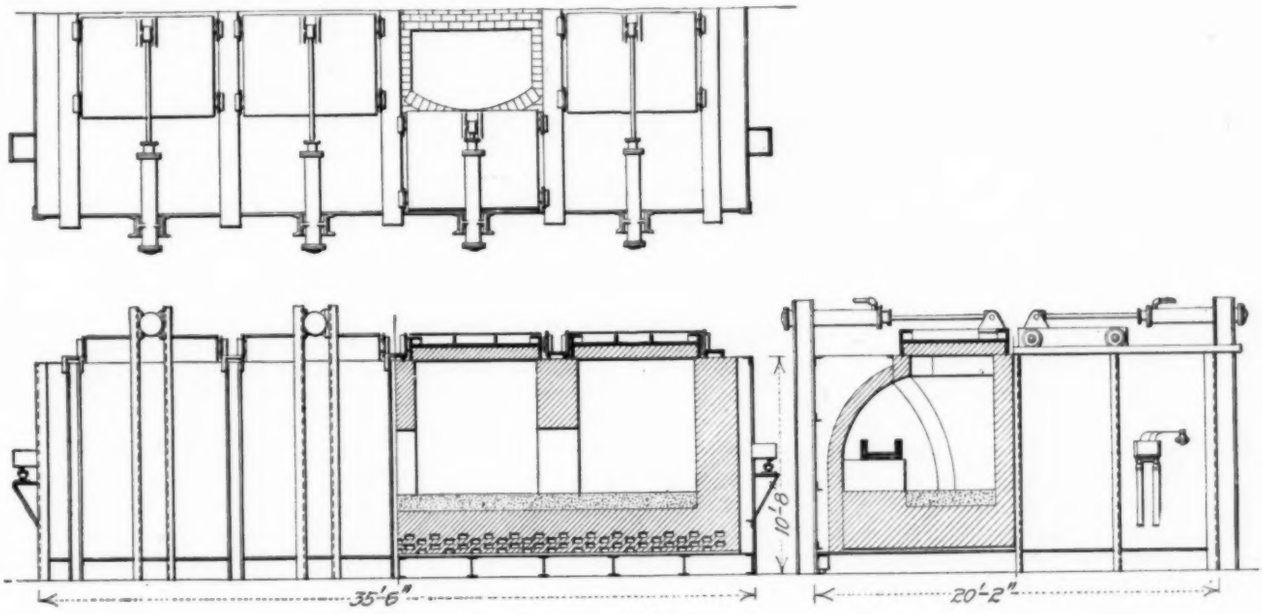


FIG. 1
Pit type furnace for soaking ingots for heavy gun forgings and ship shafts

Thus we have for a total of heating costs, including the renewals and repairs, and with power taken at ½c. per kw.-hr.:

For Hot Ingots	22½c.	per ton
For Ingots at 1800° F	35c.	" "
For Ingots at 1500° F	50c.	" "

the final temperature in each case being taken as 2100 deg. F.

These figures can be safely taken as guarantees, and it can be expected that they will be much bettered in actual practice and operation over long periods of time.

Continuous Type Re-heating Furnaces

It is believed that this type of furnace will find wide application in the heating of cold steel for forging and rolling in relatively small capacities, and in re-heating steel of high quality; but where very large tonnages of cold blooms or billets are to be heated, a combination fuel and electric furnace will be better adaptable for such work.

An application that it is believed will find favor in certain steel mill operations is the use of an electric furnace for re-heating billets for finishing mills, wherein the blooms or billets coming from one mill are too cold to put into the finishing mill and will require approximately 300 deg. additional heat.

Combination Fuel and Electric Re-heating Furnaces

Where large tonnages of cold blooms and billets are to be heated, however, unless electricity can be obtained at an exceptionally low rate, and fuel can only be had at a high cost, a combination gas and electric furnace, such as shown in Fig. 2, wherein the earlier stages of the heating up to say 1800 deg. F. are handled by fuel, and the final temperature handled electrically, is perhaps the only type that can compete with the continuous fuel-fired billet heating furnace.

The advantage of uniformity in temperature, elimination of scale, etc., and more accurate control, will justify in many cases the use of such a combination furnace.

Annealing Furnaces

Of the annealing furnaces in the steel industry, the recuperative car type will have perhaps the widest application.

Fig. 3 illustrates a recuperative type of annealing furnace.

A notable feature of these furnaces is that the annealing will be done without the usual covers required in fuel-fired furnaces ordinarily used for this work, which will constitute one of the greatest savings in annealing, as compared with present methods. The recuperative type furnace lends itself to the highest economy, as after the steel has reached the full temperature and is passing toward the discharge end of the

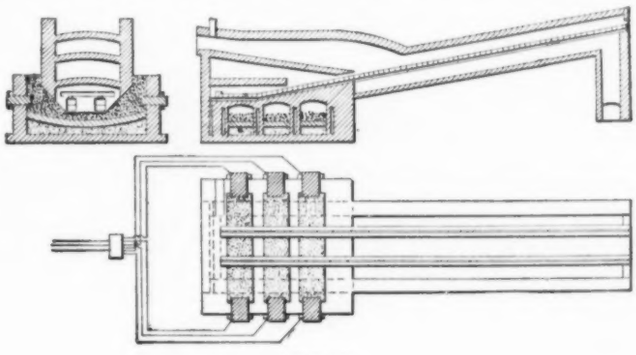


FIG. 2
All electric billet heating furnace

furnace, a large part of this heat is given up to the cold incoming material.

Taking large steel mill practice of current at one-half cent per kilowatt, the cost of annealing in this type of furnace would not exceed 60c. per ton, which will compare favorably with coal-fired annealing furnaces from a fuel standpoint, and in addition will completely eliminate the expense of covers, as well as a considerable amount of labor and will introduce a precision in annealing which it is not possible to obtain with present equipment.

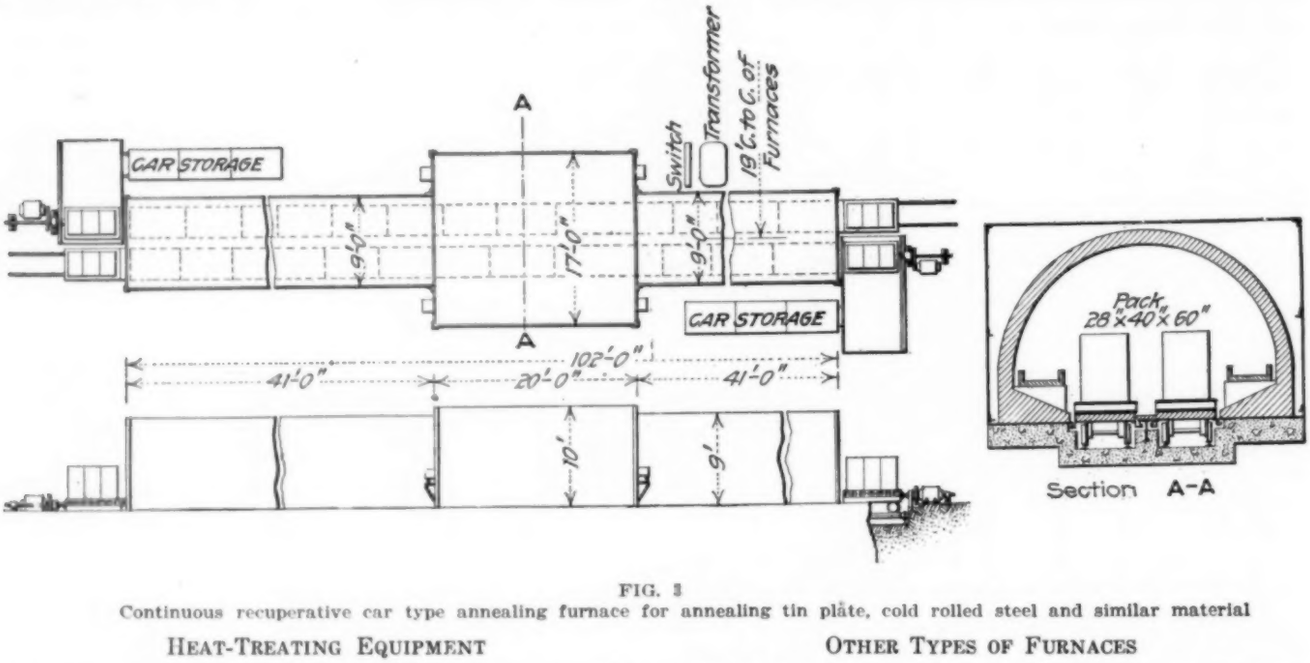


FIG. 3
Continuous recuperative car type annealing furnace for annealing tin plate, cold rolled steel and similar material

Heat-Treating Equipment

It is, however, in heat-treating equipments—which consist of two furnaces, one for the hardening temperature and one for the drawing temperature, in connection with a quenching mechanism located between—that electric furnaces have been first recognized as standard equipment for exacting work in the steel industry, and the earlier of these furnaces, especially of the automatic type, have been in use now for several years.

One of the most notable of these is an installation made at Sharon, Pa., over four years ago, which the following year was augmented by a duplicate installation.

A similar equipment of the same capacity was installed last year for the heat treatment of crank shafts for the 12-cylinder Liberty airplane motors. This equipment is shown in Fig. 4.

The steel used in these crank shafts was perhaps one of the most difficult to heat treat, and the requirements were most exacting. Opportunity for obtaining the exactness of this treatment was in this case readily available, as test pieces were taken from each end of every piece, and it is interesting to note in connection with this rigid inspection that for days at a time, when producing even several hundred cranks a day, there would not be a single rejection for any cause. This fact not only speaks well for the heat-treating equipment but for all the previous operations in connection with the steel.

Other Types of Furnaces

Fig. 5 shows a heat-treating equipment with a modification as to handling mechanism for anchor chain heat treating.

Large heat-treating furnaces of the automatic type, whose certainty of operation and precision of treatment have been clearly observed over several years, justify the consideration of the heat treatment of large tonnages of heavy material, such as steel rails. The building of equipments for such purposes presents no serious difficulty.

It is readily apparent to anyone interested in this subject that the heat treatment of rails is highly desirable, as the increased physical properties readily obtainable by a proper heat treatment are such as to very remarkably increase their efficiency, not only adding to the life from the standpoint of wear, but adding ma-

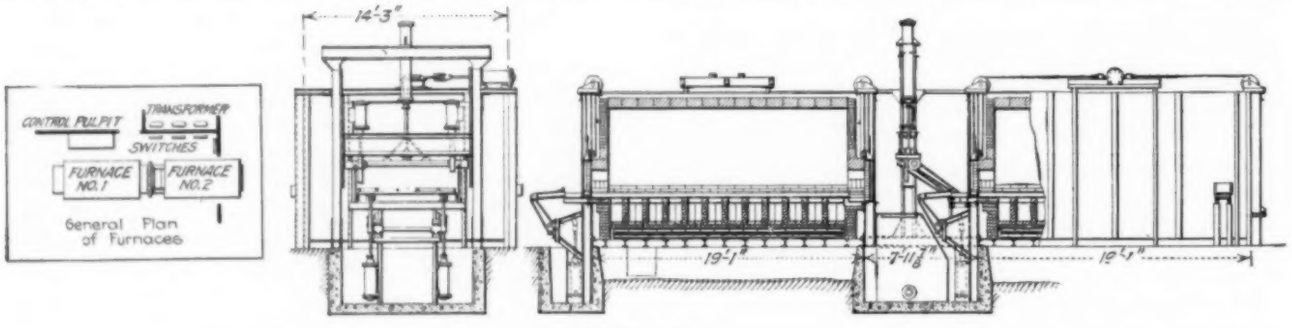


FIG. 4
Continuous automatic two-furnace heat-treating equipment, hydraulically operated, for heat-treating drawbar knuckles and airplane cranks

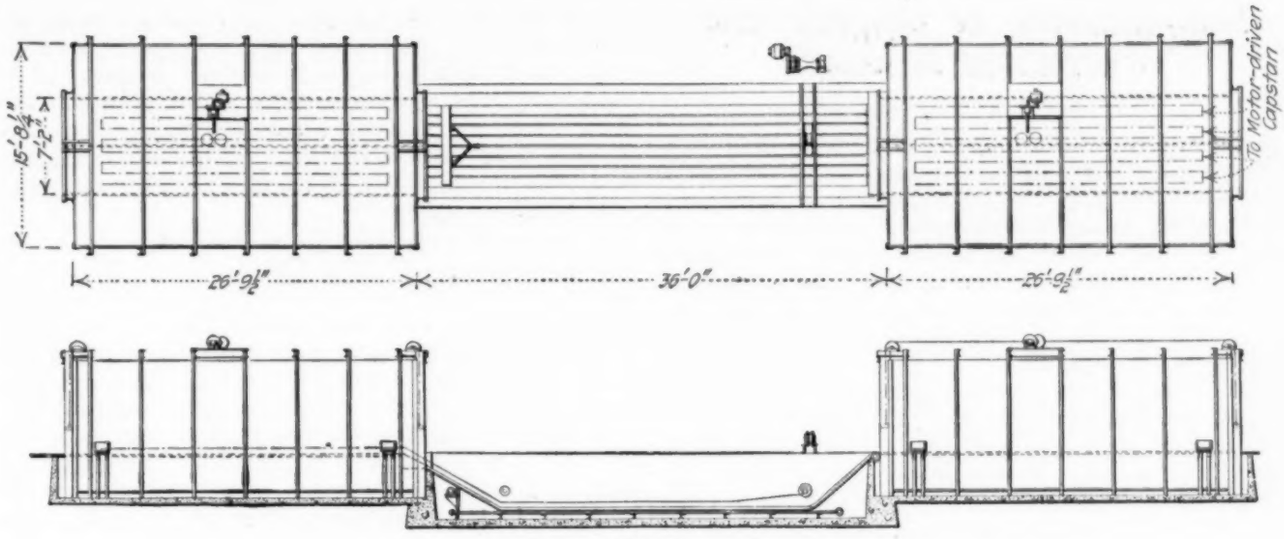


FIG. 5
Continuous two-furnace heat-treating equipment for heat-treating cast steel anchor chain

terially to the ultimate strength and the elastic limit, without appreciably sacrificing the ductility or toughness; and the only real question that can be raised is whether successful heat-treating equipments can be found wherein every rail treated will have exactly the heat treatment specified, and whether such equipment can be rugged enough to operate with precision over long periods of time, and the cost of operation come within a reasonable commercial range.

Conclusions

Where requirements of the steel specified must be met, a lower cost may readily be found in operating electric furnaces, when taking into consideration the difference between the cost per ton of material put through the furnace, as compared with the cost per ton of material meeting the specifications.

Many of the arguments used against the introduction of electric furnaces were used against the introduction of large motors in the steel mills, and against electric haulage, and the statements frequently made through all the years about any innovation that "it has not been done and it cannot be done" must gradually yield, as one by one the various types of electric furnaces from heat treating equipments to soaking pits go into regular, commercial and economical service.

Editor's Note—Professor J. W. Richards, in discussing Mr. Baily's paper, dwells on the possibility of introducing electric heating furnaces at points removed from cheap fuel and where hydro-electric power is cheap. He cites the case of the Girod Steel Works at Ugines, France, where they use entirely electric power. He also has to say to iron and steel men the following:

"Iron and steel men do not pay a fraction of the attention which they should to reduction of radiation losses from furnaces and very hot apparatus. They paint surfaces black, the best color to radiate heat, when they should be painted white. They smile the sarcastic smile of contented ignorance when it is suggested to them that heat losses can be largely diminished by proper attention to the radiating surface. Tell a foundryman that heat could be saved in sufficient quantity to pay well, if he had the outside of his furnaces nickel plated and kept them bright, and he would probably regard his informer as demented. Yet in many cases the statement would be true, and doubly true of electric furnaces.

"I strongly urge the use of white aluminum paint as one step in reducing radiation losses on furnaces. Some of our laboratory furnaces are encased in polished monel metal; it would undoubtedly be well to encase steel works electric furnaces in this manner. Even bright nickel plating of ordinary iron shells would in most cases pay for itself in heat saved in a short time.

"I plead with practical men not to ignore these 'laboratory' suggestions; they are practical, and they will save money. Mr. Baily's whole article is a demonstration of the possibility of extending the precision, accuracy and economy of laboratory methods into the steel mill. An extension of this work will mean almost the remaking of our steel industries. These are the directions for scientific progress in the steel industry."

The World's Cotton Production.—In the July, 1919, issue of *La Technique Moderne*,[1] Prof. James Dantzer presents some interesting statistics on the cotton industry of the world. From recent data, the total population of the world may be taken as 1640 millions, distributed as follows:

Asia—905 millions, or 20 inhabitants per sq.km.
Europe—420 millions, or 42 inhabitants per sq.km.
America—150 millions, or 4 inhabitants per sq.km.
Africa—150 millions, or 5 inhabitants per sq.km.
Oceania—7 millions, or 0.7 inhabitant per sq.km.

The total for 1810 was 680 millions, so the average yearly increase in population may be taken as 9 millions.

The world's cotton production for 1913 was 4886 million kg., or 2.97 kg. per capita. Of this raw cotton, 3920 million kg. was required for the production of 3500 million kg. of spun cotton (allowing 12 per cent waste), which gave, in turn, 3325 million kg. manufactured cotton goods, or 2.02 kg. per capita. The remaining 966 million kg. (0.58 kg. per capita) was used in the manufacture of absorbent cotton, guncotton, etc.

Hence, assuming the per capita requirements to average 2.97 kg., a yearly increase in population of 9,000,000 would necessitate the production of an additional 27,000,000 kg. of raw cotton.

[1] *La Technique Moderne*, July, 1919, p. 352.

Determination of Sulphur and Chromium in Steel

By Louis A. Goldenberg

A METHOD has been developed in this laboratory, whereby the same sample is used for determination of both sulphur and chromium. Sulphur is determined by the evolution method, chromium, with slight variation, by the silver nitrate-ammonium persulphate method, described by H. L. Hamner in METALLURGICAL & CHEMICAL ENGINEERING, Sept. 1, 1917, p. 206, sulphuric acid instead of hydrochloric acid being used to put the steel into solution.

A long series of tests were run, especially with reference to the sulphur determination, to make absolutely sure that the sulphuric acid would in no way influence the sulphur results. It was proved beyond doubt that the use of sulphuric acid gave results identical to those obtained when using hydrochloric acid. We have accordingly been using this method for several months.

A 3-g. sample is weighed into a 500-cc. Erlenmeyer flask, and the flask marked with the symbol Cr, when chromium is to be determined. It is attached to the evolution apparatus, which consists of a stand about a foot high, under which is an Argand burner. The Erlenmeyer is supported on this stand, and is closed with a two-holed stopper. Through one hole there is a safety thistle tube, the lower end of which reaches below the acid in the flask, while through the other there is a long tube reaching into a tumbler, which sets on the desk. Ten cc. cadmium chloride solution (1) and 150 cc. water are put into the tumbler, and 100 cc. sulphuric acid solution (2) poured through the thistle tube, and the burner lighted. When evolution is complete, the flask is disconnected, the thistle tube washed down, and the flask set aside for the determination of chromium. The presence or absence of chromium is shown positively by the color of the solution, chromium giving the solution a decided deep green that cannot be mistaken, so that should any alloy steel come into the laboratory marked as a plain carbon steel, the mistake is detected at once, and the sample run for chromium, without having the routine interrupted in any way.

To the tumbler is added 2 cc. starch solution (3) and 25 cc. hydrochloric acid solution (4) are run in, and it is titrated immediately with a standard potassium iodide-potassium iodate solution (5) to a deep blue end point.

To the solution remaining in the flask is added 10 cc. nitric acid-silver nitrate solution (6), the flask is placed on the hot plate, and boiled gently, until nitrous fumes are completely expelled. It is diluted to 300 cc., heated to boiling, 10 cc. ammonium persulphate (7) carefully added, and boiled until manganese dioxide is completely precipitated. Now 2 cc. hydrochloric acid (1 : 1) is added slowly to prevent sudden boiling over, to destroy the manganese dioxide, and the flask is gently boiled for 15 min., until the silver chloride which has been formed is entirely coagulated.

The flask is then cooled in running water, 2 cc. potassium ferricyanide (1 per cent) added and titrated to a deep blue end point, with standard ferrous ammonium sulphate solution (8), which has been standardized against a standard government steel.

1. Cadmium Chloride Solution.—Dissolve 180 g. $CdCl_2$ in 7200 cc. H_2O, then add 10,800 cc. NH_4OH.

2. Sulphuric Acid Solution.—To 14,750 cc. water add 3250 cc. H_2SO_4.

3. Starch Solution.—Mix 10 g. starch in about 15 cc. cold water, add about ¼ in. stick NaOH, and stir until mass gelatinizes. Add cold water until mass is liquid and put it into 500 cc. boiling water, and boil 2 to 3 minutes.

4. Hydrochloric Acid Solution.—To 3600 cc. water add 14,400 cc. HCl.

5. Standard Potassium Iodide-Potassium Iodate Solution.—Dissolve 12.0528 g. KIO_3 and 130 g. KI, and dilute to exactly 18 liters. Standardize against a standard steel of known sulphur content, following the same directions as given above, and using for a factor the results obtained by dividing the known sulphur content by the number of cc. of standard solution required.

6. Nitric Acid-Silver Nitrate Solution.—Dissolve 540 g. $AgNO_3$ in H_2O, dilute to 11,000 cc., add 7000 cc. HNO_3.

7. Ammonium Persulphate Solution.—Dissolve 5400 g. $(NH_4)_2S_2O_8$ in water, and dilute to 18 liters.

8. Ferrous Ammonium Sulphate.—Dissolve 432 g. $Fe(NH_4)_2(SO_4)_2$ in H_2O, dilute, add 180 cc. H_2SO_4, and dilute to 18 liters. Standardize against a standard steel of known chrome content, running in the same way as above, and using for factor the results obtained by dividing known chrome content by number of cc. standard required. Or standardize against $KMnO_4$, by running about 40 cc. $Fe(NH_4)_2(SO_4)_2$ out of a burette into 100 cc. H_2O, adding 5 cc. H_2SO_4 and titrating with $KMnO_4$. One cc. N/10 $KMnO_4$ equals 0.00173 g. Cr.

The principal advantage is the saving in time, of weighing up the sample, and putting it in solution in sulphuric acid. It is also of great advantage in time saving to have the sample ready to run for chromium, if due to error in marking sample, no chromium has been weighed up. In this connection, the color of the acid solution in the flask is an absolutely sure indication of the presence or absence of chromium.

In comparing the silver nitrate-ammonium persulphate method with the older one, of oxidizing with potassium permanganate and filtering off the manganese dioxide, the saving in time here also is very great. This, however, is taken up by the originator of the method, Mr. Hamner, in his original article.

However, two advantages of our method over those of Mr. Hamner might be mentioned. In dissolving a large number of samples in open beakers, the contents of some of the beakers invariably evaporate faster than others, so that unless constantly watched, spattering results. This is entirely done away with where the solution takes place as described, because the original volume of acid is not changed by evaporation.

Furthermore, in titrating, using one solution instead of two is an advantage, although of course the sample cannot later be titrated for vanadium. Also, the deep blue ferricyanide end point is much sharper, and leaves less to the operator's individual judgment than the permanganate end point.

One last item might be mentioned in connection with the sulphur determination. When hydrochloric acid is used as a solvent—hydrochloric acid often volatilizes, and is driven over into the cadmium chloride, where it tends to neutralize some of the ammonia, and rise from the tumbler as ammonium chloride. This is especially likely to happen, if, in an attempt to hurry the operation, the flame under the flask be raised too high. When using sulphuric acid, however, this does not occur.

Lime-Barium Softener for Treatment of Boiler Feed Water

Description of a Successful Water-Softening Installation for the Production of Sulphate-Free Boiler Water—Operating Procedure: Charging and Washing Filters, Sampling and Analyzing, Gaging Flow With Weir—Water Reports

By C. A. MEHRING

THE method of softening water for boiling purposes by the lime-barium treatment has been carried on with considerable success for the past two years at the Chino Copper Co.'s plant at Hurley, N. M. The softeners used are manufactured by the Reisert Automatic Water Purifying Co. of New York. The apparatus consists of a raw water tank, a settling tank with gravel and filter embodied, a lime slacking tank, a saturator and sludge tank.

The raw water is admitted to the plant through a float valve at the end of the raw water pipe *E-1*. Through this valve the water is discharged into the small compartment of the raw water tank. The float valve is controlled by a float in the settling tank, or a filter compartment, which is raised or lowered in proportion to the amount of soft water drawn off. From the small compartment the water passes through a rectangular weir into the large siphon compartment. Through this siphon the water is discharged into a siphon discharge tank riveted to the bottom of the raw water tank. The air which accumulates here escapes through vent *Y*. From the discharge tank the water flows intermittently through pipe *D*, *D-1* to the bottom of the outer, or lime, cone.

The Lime Saturator

The lime saturator is a cone-shaped tank, consequently all suspended matter and precipitate settle to the bottom and can be drawn off through cock *R* to sewer. The suspended matter and precipitate are due to the make-up of the raw water and insoluble calcium carbonate in the lime. The required amount of lime for the saturator is slacked in the slacking tank by the addition of just enough water to make the consistency of cream. This lime is added to the saturator through cock *H-1* and pipe *H* into the bottom of the saturator. The raw water from the raw water tank is admitted to the saturator through a rectangular weir *J-1* and pipe *J*. This water entering the bottom of the saturator comes in contact with the cream of lime and on its way to the lower cone through pipe *K*, *K-1* and *K-2* becomes saturated with lime. This lime water meets the raw water at the bottom of the lower cone, removing the temporary hardness. The precipitates settle out and sink to the bottom of the cone. From here they are drawn off through cock and pipe *N* to sewer. The water then rises from the lower cone and enters the inner, or barium, cone, through pipe *C*, which has the same diameter as the siphon pipe. The speed of the water flow is very high, consequently the barium carbonate is thoroughly stirred up so that it comes into intimate contact with the water, removing the sulphates. The reactions take place in the water on its way to the top of the inner tank. Here the area is greatly increased, hence the speed of the water is materially decreased, allowing the precipitate of barium sulphate to settle and sink to the bottom of the inner cone. Therefore most of the precipitate is removed before the water reaches the holes near the top of the main tank. Through these holes the water flows into the outer annular space which contains the filter.

The Filter

The filter consists of a perforated plate, a brass screen, 6 in. of gravel and 16 in. of sand. The softened and filtered water is collected in a triangular space below the filter bottom. From here it is drawn off through pipe *B* and *B-1*, in which pipe line a shut-off valve is provided to prevent the raw water from entering softened water storage tank while the filters are being washed. This pipe is raised sufficiently above the sand so that should the raw water be shut off entirely, the water will not be lowered below the sand on the filter. In the space below the filter bottom is an annular perforated pipe *G* for the air wash. For an even distribution the air is admitted at four points. This is also the case with the wash water pipe *E*, which connects with the raw water pipe *E-1*. Above the sand four semi-circular baffles are provided at the end of pipe *A*. These baffles prevent any sand from being washed over through pipe *A-1*, *A-2* to sewer while filters are being washed.

Method of Charging Softeners and Washing Filters

The valve 5 at the end of the raw water pipe *E* is closed, preventing any water from entering the softener. Cock *R* is opened, sludging out the lime saturator. This cock is left open until the heavy precipitate is all washed out, or until the water becomes almost clear. Cock *N* is opened, allowing the sludge from the lower, or lime, cone, to flow to the sewer. This cock is left open until the water is almost clear. Cock *M* is opened, allowing the precipitate of barium sulphate and unused barium carbonate to flow into the sludge tank. From this tank it is forced back into the lower, or lime, cone, by means of a steam injector. Valve 1 is closed, shutting off the water through pipe *B*, thus preventing its entering the soft water storage tank. Valve 4 is opened cautiously, as this is the high pressure air which escapes through the perforated annular pipe under the sand and gravel of the filter. Care must be taken not to agitate too violently, lest sand and gravel become mixed. The action of the air loosens the precipitate which has adhered to the sand and gravel of the filter. Valves 2 and 3 are then opened. Valve 3 allows the raw water to rise through the filter-bed, washing all precipitate, loosened by the action of the air through valve 2 and filter sludge pipe, to sewer. When filter is sufficiently washed, valves 4, 3 and 2 are closed, and valve 1 opened, allowing softened water to flow to storage tank when softener is again in operation. The required amount of barium carbonate is then charged to the barium cone through the barium funnel. The lime in the lime slacking tank,

which has been slacked to creamy consistency, is charged to the bottom of the lime saturator through cock *H-1*, and pipe *H*. Valve 5 is opened, allowing the water to flow to the siphon tank. The float on this valve automatically controls the operation of the softener for the remainder of the shift. The operation of charging, sludging and washing filters is performed every 12 hours.

Method of Collecting Samples

All water samples are drip samples taken by means of ¾ in. pipes connected at various places on the softeners: The raw water connected on pipe *E-1;* the saturated lime water on pipe *K-2* in the lower, or lime, cone; the softened or treated water on the triangular space below the filter bottom. These drip samples cover a period of 12 hr., at the end of which time they are analyzed. At the end of sludge pipe *N* a sample is taken at time of sludging and analyzed for barium carbonate. This is done as a precaution against an undercharge or overcharge.

Method of Analysis

The method of analysis indicates the following in equivalent amounts of calcium carbonate:

1. Alkalinity to methyl orange (M.O.Alk.)
2. " to phenolphthalein (Pt.Alk.)
3. Free carbon dioxide.
4. Negative hardness (Na_2CO_3)
5. Temporary hardness.
6. Permanent "
7. Magnesia.

Solutions Required

Standard N/25 H_2SO_4

1 cc., equivalent to 0.002 grain $CaCO_3$

Standard N/10 Na_2CO_3

1 cc. is equivalent to 0.005 grain $CaCO_3$

Standard N/10 (Na_2CO_3 and NaOH equal parts), called soda reagent.

1 cc. is equivalent to 0.0005 grain $CaCO_3$

Distilled water neutral to methyl orange.

Methyl orange indicator (M.O.)

Phenolphthalein indicator (Pt.)

1. Alkalinity to Methyl Orange.—Titrate 100 cc. of water with N/25 H_2SO_4, using methyl orange indicator. Cc. of acid used times 1.17 equals the alkalinity to methyl orange in grains per gallon.

2. Alkalinity to Phenolphthalein.—Titrate 100 cc. of water with N/25 H_2SO_4, using phenolphthalein indicator. Cc. of acid used times 1.17 equals the alkalinity to phenolphthalein in grains per gallon.

3. Free Carbon Dioxide.—Titrate 100 cc. of water with N/25 Na_2CO_3, using phenolphthalein indicator. The first faint tinge of pink is the end point. Cc. of Na_2CO_3 used times 1.17 equals the free CO_2 in grains per gallon.

4-5. Permanent or Negative Hardness.—Boil 100 cc. of water 10 min., add 5 cc. N/10 "soda reagent." Boil further to ½ volume. Filter, wash and titrate all of the filtrate with N/25 H_2SO_4, using methyl orange indicator [(5 cc. "soda reagent" times 2½)—cc. acid used] times 1.17 equals permanent hardness if plus, or negative hardness if minus, in grains per gallon.

6. Temporary Hardness.—Temporary hardness is equal to the methyl orange alkalinity minus the negative hardness.

7. Sulphates of Iron, Aluminum, Magnesium, etc., Classed as Magnesia.—Boil solution from determination No. 1 in a covered beaker 15 min., add 25 cc. saturated lime water and allow to stand near boiling temperature 15 min. Filter, wash and titrate all of filtrate with N/25 H_2SO_4 using methyl orange indicator. Cc. acid used = X. Run blank in same manner, using distilled water with cc. acid = Y. Then $(Y - X)$ 1.17 = magnesia, etc., in grains per gallon.

Chemistry of Process

Reactions of impurities and lime.

$$CO_2 + Ca(OH)_2 = CaCO_3 + H_2O \quad (1)$$
$$CaH_2(CO_3)_2 + Ca(OH)_2 = 2CaCO_3 + 2H_2O \quad (2)$$
$$MgH_2(CO_3)_2 + 2Ca(OH)_2 = Mg(OH)_2 + 2CaCO_3 + 2H_2O \quad (3)$$
$$FeH_2(CO_3)_2 + Ca(OH)_2 = FeCO_3 + CaCO_3 + 2H_2O \quad (4)$$
$$FeSO_4 + Ca(OH)_2 = Fe(OH)_2 + CaSO_4 \quad (5)$$
$$Fe_2(SO_4)_3 + 3Ca(OH)_2 = 2Fe(OH)_3 + 3CaSO_4 \quad (6)$$
$$Al_2(SO_4)_3 + 3Ca(OH)_2 = 2Al(OH)_3 + 3CaSO_4 \quad (7)$$
$$CuSO_4 + Ca(OH)_2 = Cu(OH)_2 + CaSO_4 \quad (8)$$
$$H_2SO_4 + Ca(OH)_2 = CaSO_4 + 2H_2O \quad (9)$$
$$MgSO_4 + Ca(OH)_2 = Mg(OH)_2 + CaSO_4 \quad (9A)$$

Reactions of impurities and $BaCO_3$

$$CaSO_4 + BaCO_3 = BaSO_4 + CaCO_3 \quad (10)$$
$$2FeSO_4 + 2BaCO_3 + H_2O = FeH_2(CO_3)_2 + Fe(OH)_2 + 2BaSO_4 \quad (11)$$
$$Fe_2(SO_4)_3 + 3BaCO_3 = 2Fe_2(CO_3)_2 + 3BaSO_4 \quad (12)$$
$$Al_2(SO_4)_3 + 3BaCO_3 + H_2O = BaSO_4 + Al(OH)_3 + 3CO_2 \quad (13)$$
$$CuSO_4 + BaCO_3 = CuCO_3 + BaSO_4 \quad (14)$$
$$H_2SO_4 + BaCO_3 = BaSO_4 + H_2O + CO_2 \quad (15)$$

Reactions of impurities and Na_2CO_3

$$CO_2 + Na_2CO_3 + H_2O = 2NaHCO_3 \quad (16)$$
$$CaSO_4 + Na_2CO_3 = Na_2SO_4 + CaCO_3 \quad (17)$$
$$FeSO_4 + Na_2CO_3 = FeCO_3 + Na_2SO_4 \quad (18)$$
$$Fe_2(SO_4)_3 + 3Na_2CO_3 = Fe_2(CO_3)_3 + 3Na_2SO_4 \quad (19)$$
$$MgSO_4 + Na_2CO_3 = MgCO_3 + Na_2SO_4 \quad (20)$$
$$Al_2(SO_4)_3 + 3Na_2CO_3 + H_2O = 2Al(OH)_3 + 3Na_2SO_4 + 3CO_2 \quad (21)$$
$$H_2SO_4 + Na_2CO_3 = Na_2SO_4 + CO_2 + H_2O \quad (22)$$

Reactions of impurities and NaOH

$$CO_2 + NaOH = NaHCO_3 \quad (23)$$
$$MgCO_3 + NaOH = Mg(OH)_2 + Na_2CO_3 \quad (24)$$

$MgCO_3$ is a product of reaction (20)

$$FeSO_4 + 2NaOH = Fe(OH)_2 + Na_2SO_4 \quad (25)$$
$$Fe_2(SO_4)_3 + 6NaOH = 2Fe(OH)_3 + 3Na_2SO_4 \quad (26)$$
$$Al_2(SO_4)_3 + 6NaOH = 2Al(OH)_3 + 3Na_2SO_4 \quad (27)$$
$$CuSO_4 + 2NaOH = Cu(OH)_2 + Na_2SO_4 \quad (28)$$
$$H_2SO_4 + 2NaOH = Na_2SO_4 + 2H_2O \quad (29)$$

TABULATED DATA REDUCED FROM EQUATIONS 1-29

Equivalent Parts $CaCO_3$

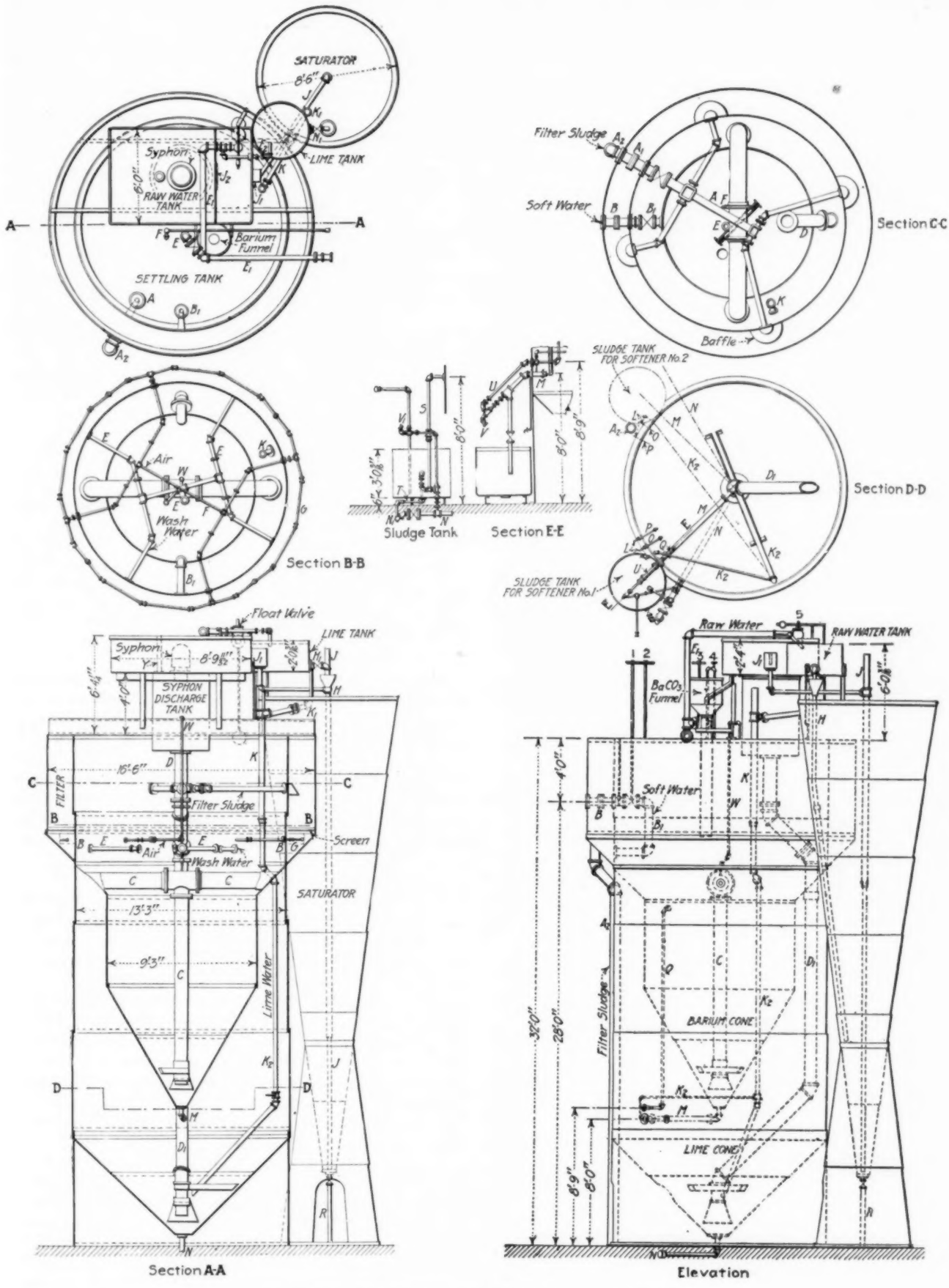
One Part Impurity	Requires for Treatment: Parts CaO		$BaCO_3$		Na_2CO_3	Impurity Indicates Equivalent Parts $CaCO_3$
Free CO_2	1					1
$NaHCO_3$	2					2
$CaH_2(CO_3)_2$	1					1
$MgH_2(CO_3)_2$	2					2
$FeH_2(CO_3)_2$	1					1
$CaSO_4$	...		1	or	1	1
$MgSO_4$	1	and	1	or	1	2
$FeSO_4$	1	and	1	or	1	2
$Fe_2(SO_4)_3$	3	and	3	or	3	6
$Al_2(SO_4)_3$	3	and	3	or	3	6
$CuSO_4$	1	and	1	or	1	2
H_2SO_4	1	and	1	or	1	2

Each equivalent part of $CaCO_3$ requiring CaO for treatment requires 0.56 parts CaO.

Each equivalent part of $CaCO_3$ requiring $BaCO_3$ for treatment requires 1.97 parts $BaCO_3$.

The impurities in water causing hardness are:

Non-scaling	Free CO_2 (corros.)	Negative hardness	
	$NaHCO_3$		
	$CaH_2(CO_3)_2$	Temporary hardness	
	$MgH_2(CO_3)_2$		
	$FeH_2(CO_3)_2$		
Scaling — Non-corrosive	$CaSO_4$	Permanent hardness	
	$MgSO_4$		
	$FeSO_4$		
Scaling — Corrosive	$Fe_2(SO_4)_3$		
	$Al_2(SO_4)_3$		
	$CuSO_4$		
	H_2SO_4 (non-scaling)		



14,000-GAL. LIME-BARIUM WATER SOFTENER PLANT

$FeSO_4$, $Fe_2(SO_4)_3$, $Al_2(SO_4)_3$, $CuSO_4$, H_2SO_4, etc., are occasionally found in boiler waters. These impurities are precipitated by $BaCO_3$.

Method of Setting Weir to Lime Saturator

On the raw water compartment of the siphon tank are two rectangular weirs *J-1* and *J-2*. *J-2*, the larger weir, is 3.5 in. wide. *J-1*, the small weir, is 1.25 in. wide. The two weirs are at the same height from the bottom of the raw water box, hence a proportionate amount of water may be discharged through each.

Method of setting weir *J-1* to lime saturator so that the required amount of saturated lime water may be discharged from the saturator to the lower, or lime, cone of softener.

The raw water must be analyzed at the beginning of each shift to find the required amount of lime to be added to the saturator. For example:

Temporary hardness	=	12.9
Twice negative hardness 1.6	=	3.2
Magnesium	=	6.1
Free CO_2	=	0.0
Total	=	22.2 = Grains per gal. $CaCO_3$.

$CaCO_3 : 22.2 :: CaO : x$.
x = acid carbonates.
Saturation of lime water : acid carbonates : : 3.5 in. (width of weir *J-2*) : x.
x = width of opening in weir *J-1*.
Barium Carbonate Required.—$CaCO_3$ equivalent of the permanent hardness of the raw water in grains per gallon $\times \frac{1.97}{7}$ = lb. of C.P. $BaCO_3$ required to treat 1,000 gal. of water.

WATER ANALYSIS MADE BY THE DEARBORN CHEMICAL CO

332 South Michigan Avenue, Chicago

Sample of Water marked Composite Sample Apache Tejo Raw, Month February, 1919, Req. No. 2123-H

Lab. No. 68593 — March 15, 1919.

Mineral Analysis	Grains per Gal.
Silica	0.691
Oxides of iron and aluminum	0.046
Carbonate of lime	7.416
Sulphate of lime	None
Carbonate of magnesia	4.247
Sodium and potassium sulphates	6.422
Sodium and potassium chlorides	2.380
Sodium and potassium carbonates	1.592
Loss, etc	0.215
Total soluble mineral solids	23.009
Organic matter	Trace
Suspended matter	0.350
Pounds soluble incrusting solids per 1,000 U. S. gal	1.77
Total soluble incrusting solids, grains per gal	12.400
Total soluble non-incrusting solids, grains per gal	10.609

REPORT OF ANALYSIS ON SAMPLE OF WATER

Marked Composite Sample Apache Tejo, Treated, Month of Feb., 1919, Req'n No. 2123-H

Lab. No. 68595 — March 15, 1919.

Mineral Analysis	Grains per Gal
Silica	0.233
Oxides of iron and aluminum	0.035
Carbonate of lime	0.817
Sulphate of lime	None
Carbonate of magnesia	0.867
Sodium and potassium sulphates	6.422
Sodium and potassium chlorides	2.380
Sodium and potassium carbonates	1.626
Loss, etc	0.117
Total mineral solids	12.497
Organic matter	Trace
Total incrusting solids	1.952
Total non-incrusting solids	10.545
Pounds incrusting solids per 1,000 U. S. gal	0.28
Pounds non-incrusting solids per 1,000 U. S. gal	1.51

Contains a trifle less than 12½ grains of mineral matter and a trace of organi matter per U. S. gal. of 231 cubic inches.

DEARBORN LABORATORIES,
(Signed) W. A. Converse,
Chemical Director.

COST OF TREATMENT

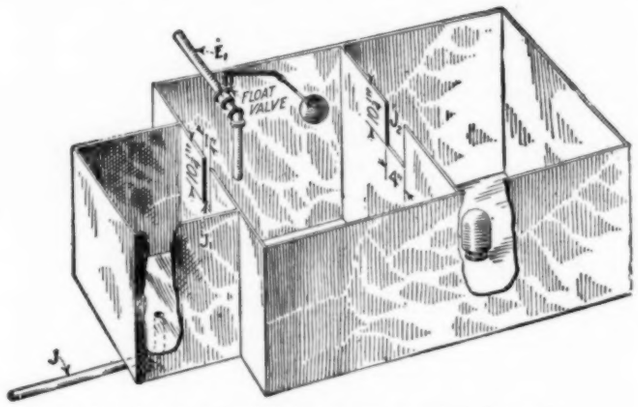
Month of February, 1919

83 bbl. lime at $2.18 per bbl	$180.94
1,040 lb. $BaCO_3$ at $3.27 per cwt	34.01
Labor operation	164.00
Miscellaneous supplies	5.84
Steam for injector	5.35
Total cost of treating 6,697,000 gal. water	$390.14
Cost of treating 1,000 gal. water	.058

MISCELLANEOUS DATA—AVERAGE FOR THE MONTH

Lb. of incrustants in raw water	11,920
Lb. incrustants removed	10,045
Lb. incrustants in treated water	1,875
Lb. incrustants in 1,000 gal. raw water	1.78
Lb. incrustants in 1,000 gal. treated water	.28
Cost to remove 1 lb. incrustant	$0.038

Considerable experimental work has been done on different waters, from spring water to tailings water from a copper precipitating plant, showing that most any



CONTROL WEIRS ON RAW WATER TANK

water can be treated satisfactorily in this type of softener.

Before the installation of this softener, trouble was experienced due to priming and foaming of the boilers and to a large amount of very hard scale which was difficult to remove, but since the operation of this plant these troubles have been eliminated.

New Metal Alloy

During the war an Italian engineer, Adolfo Pouchain, after a series of experiments succeeded in producing a new alloy of zinc and copper, which has been given the name "biakmetal." This alloy quickly demonstrated its usefulness in Italian industry, and by reason of its special qualities promises to attain similar success throughout the world. Biakmetal has aroused considerable interest in Italy. A certain large manufacturer has said that his metallurgists have made every effort to determine its exact composition, but without success.

From a small beginning the demand for biakmetal has increased to such an extent that a new company, the Stabilimenti Biak, S. A., of Turin, having a capital of 12,000,000 lire ($2,316,000), has been formed to carry on its manufacture. The industrial value of a product which is stronger than steel and less corrosive than copper is evident, and it is claimed that biakmetal, which has passed the experimental stage, possesses these qualities. The most important characteristics are stated to be as follows: (1) The highest known breaking point; (2) the highest limit of elasticity; (3) perfect homogeneity; (4) high resistance to thermic action; and (5) high resistance to chemical action.

Biakmetal is extremely well adapted for almost any kind of manipulation. It can be successfully cast, turned, drawn, forged, rolled and stamped. While its development is still in progress, it has already proved especially useful in aëronautic and marine construction on account of its light weight, its unusual strength and its anti-corrosive qualities. In its different forms it may be substituted for steel, brass and aluminum, and for certain uses has important advantages

Operation of a Gas Producer

By J. S. McClimon*

MOST articles on gas producer operation consist of a long discussion of theoretical conditions or chemical reactions. It is the aim of this article to reduce the causes and effects of these things to a rule-of-thumb method which will be of assistance to the operator or superintendent and may be applied to everyday operating conditions met with in producer practice.

Starting the Producer

A new producer, before being started, should be dried out several days with small fires. This is a precaution which, if properly carried out, will add considerably to the life of the lining. After the producer has been thoroughly dried, all large pieces of wood likely to cause trouble should be removed and the producer filled with ashes to a depth of at least 12 in. over the top of the blower. It is best that a few large clinkers be placed around the openings of the blower to keep them from becoming clogged with fine ashes. These ashes are necessary to protect the metal parts of the producer. They also act as a diffusing medium to distribute the blast over the entire fuel bed, thus insuring even combustion.

To start the producer, it is necessary only to level off ashes, throw in several armfuls of small dry wood, saturate with kerosene, and light with a piece of waste. After the wood has burned for a few moments, turn on about 10-lb. blast and blow until the wood is well ignited. A small amount of coal can then be dumped and the fires be built up gradually. Care should be taken that the coal is not fed too fast. Allow a good bed of coke to be formed before any attempt is made toward crowding the operation of the producer. One should remember that it takes several hours to get a producer fire built up properly to the point where it is making good gas.

No special attempt need be made at this point to get the fire distributed over the entire fuel bed. It will spread of itself later, and it is usually better to have a good fire at one point than several small ones scattered over a larger area.

In case it is necessary to stop the producer at any time, the blast should be turned off immediately and never exceed 10 lb. during this idle period.

Three Zones

The various zones of the producer are shown in Fig. 1. It can be seen that there are three—the ash, the incandescent or the fire zone, and the green coal zone, the last consisting of coal which has not received a sufficient amount of air to become incandescent. This is also termed the distillation zone. The existence of these three zones is a point often overlooked in the operation of the producer.

Measuring Fires

The usual method of measuring the fires is for the foreman to take a rod about 5 ft. long, which he inserts in one of the poke-holes in the producer top until he establishes the height of the fuel bed. This method is totally inadequate, because no attention is given to the depth of the fire zone, the most important point of all in the operation of a gas producer. If the ash zone is allowed to exceed a reasonable limit, say 15 in., the fire zone is considerably reduced, and it is impossible to carry the proper depth of fire if the ashes are not kept within a reasonable limit. This tendency of the ashes to crowd out the fire zone makes it possible for the top of the fuel to be at the proper height and yet the fire may be so thin that the gas will be of exceedingly poor quality.

The only way the fires can be measured properly is to force the rod completely through the fire and allow it to remain long enough to become red hot. After the rod has been withdrawn, it is easy to see the part which has been in contact with the hottest portion of the fire and the part which has been protected by the ashes. Knowing the distance to the blower or the metal parts of the producer, it is a simple matter to tell exactly the depth of the various zones.

A very convenient rod for this work is shown in the view and consists of a ¾-in. gas pipe marked into 2-ft. sections by ¼-in. rivets running through the pipe. Any other method of marking may be used which will not be destroyed by the action of the fire or interfere with the passage of the pipe through the fuel bed. A mark is also placed at the height equal to the distance between the blower and the producer top. This indicates the distance the rod should be forced into the producer. In using the rod, the distance to the top of the fuel bed is first determined. (See Fig. 1.) The rod is forced through the fuel bed until the lower end is on a level with the top of the blower and allowed to remain there for two or three minutes. This is usually all the time necessary for the rod to remain in the fire. On being withdrawn, it will be noted that there are two parts which show up distinctly—one a smoky black extending for several feet, and the other a very hot portion usually from 12 to 14 in. in length. This latter

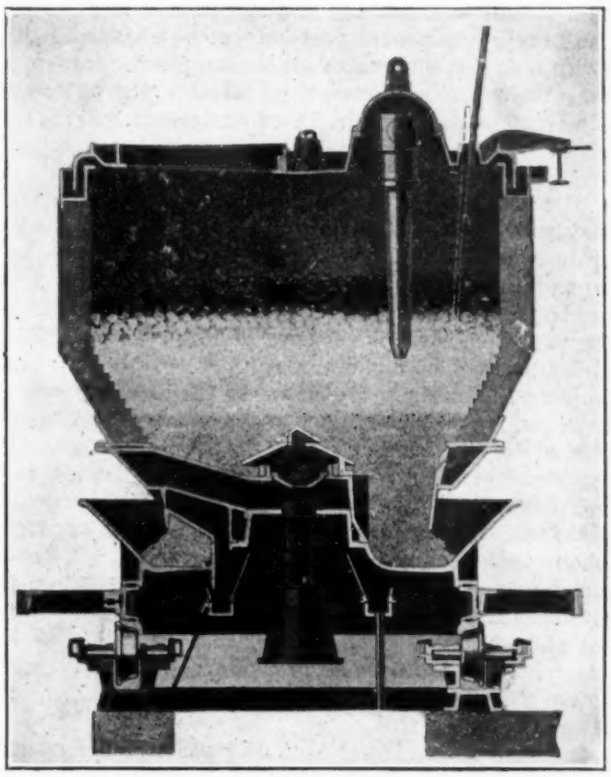


FIG. 1
IDEAL CROSS SECTION OF PRODUCER

*Assistant Engineer, Gas Producer Department, Wellman-Seaver-Morgan Co., Cleveland, Ohio.

indicates the incandescent zone. Below the lower point of this zone and the end of the rod, there is a portion not affected by the heat and it should not be very hot. This is the ash zone and should never be less than 6 in. and seldom, if ever, exceed 15 inches.

Between the highest point of the hot portion of this rod and the distance determined to the top of the fuel there will be a space of from 6 to 12 in. This is the green coal zone. If the coal is of a tarry nature, it is possible that this zone will stand out distinctly by a tarry deposit upon the rod which can be readily distinguished from the sooty deposit above this section. The sooty portion of the rod represents the part in contact with the gas.

It is not intended that this method of measuring the fires should be employed more than two or three times per day, depending upon the number of times the fires are cleaned, but this is the only way the ash zone and the fire zone can be measured and the amount of ashes that it will be necessary to remove be determined. If the fires are measured just before the change of turns twice a day, it eliminates all chance for the men to excuse their own indifference by blaming the other shift for trouble which might be of their own making.

Hot or Cold Gas

The green coal zone mentioned in previous paragraphs may vary with requirements. If it is intended to generate a hot gas, that is, gas leaving the producer at a temperature of about 1200 deg. F., the coal zone should not be allowed to exceed 6 to 8 in. The gas showing when the poke-hole cover is removed will be a brownish-black and a small pilot flame or color cone of about 3 in. in length will appear in the center of the escaping gas. If, however, it is desired to generate what is termed a solid gas, a deeper layer of coal must be carried over the incandescent fuel. This may be anywhere from 8 to 15 in., depending more especially upon the nature of the fuel. Under these conditions, the gas appearing when the poke-hole cover is removed will be a bluish-white and the temperature when leaving the producer may be as low as 700 deg. F. This is by far the richest and best gas for most purposes. The hot gas usually carries a B.t.u. value per cu.ft. of about 150, while the cold gas may have a value of 170 to 180 B.t.u. per cubic foot.

Some operators insist that cold gas will not operate efficiently in open hearth furnaces or other places where it is desired to carry a melting temperature. This is a matter open to some discussion. We know of several open hearth plants in very successful operation using cold gas by preference.

Points of Attention

Some coals have a tendency to become soft and pasty under the action of the heat in the producer. This restricts the passage of the gas, and owing to the fact that the pressure accumulates under the steady blast, the gases will seek channels to break through the resistance of the fuel bed. These points then become excessively hot, melting the ashes and other foreign particles in the coal which form the basis of clinkers.

If the coal in use is of this nature, care should be taken to see that these channels do not form. This can be done by close attention to the stirring and the regulation of the blast, or it may be necessary to change the mixture of the blast, increasing the proportion of steam to the amount of air blown. This will lower the temperature of the fire and thus considerably decrease the tendency for the fires to clinker. It should be remembered that the change should not be carried to the point where the CO_2 content in the gas becomes excessive or the fires are so cooled that the carbon in the coal is not properly gasified. Either of these items determined a certain amount of loss, but the situation should be considered as a whole and decision made as to whether the stoppage due to clinkering and the extra labor attendant to the same are not more than an offset for the few percentages of the CO_2 or a slightly increased amount of carbon in the ashes.

Cleaning the Fires

It is the usual custom to clean the fires two or three times a day, depending upon the amount of coal burned and the percentage of the ash in the coal. It is not necessary that the operation of the producer be discontinued during the cleaning period. The fire should never be lowered more than 8 or 10 in. during one cleaning period, and the coal should be dumped as during the regular period, although usually in smaller amounts. It is beter to lower the pressure on the blowers 10 or 15 lb. during this period. If two or more producers are arranged to operate on the same line, the other products should be blown slightly harder during this interval, and if this operation is properly carried out, the entire battery of producers may be cleaned without the slightest effect noticed in operation of the furnaces. During the cleaning period careful attention should be given to any clinker formations that are likely to appear on the side wall. These should be broken loose and the side walls kept clean.

Feeding Coal

The proper dumping and distribution of the coal charges have a decided bearing upon the conditions obtained in producer operation. The coal should be dumped in as small quantities as can be conveniently arranged and strict attention should be paid to the color and appearance of the gas, which shows whether or not the fuel bed is of the proper thickness.

Steam Requirements

The amount of steam required to blow the producer varies with requirements. If it is necessary to crowd the machine, more aid is needed to burn the increased amount of coal and as the proportion of steam and air must be maintained, it is only necessary to increase the steam pressure until the proper amount of aid is delivered. This in no way affects the quality of the gas if the fires are kept in the proper condition. Gas of just as good quality can be made at 100 lb. pressure as at 15 lb.—only the volume will be greatly increased and it is possible for the fires to get out of order much more quickly. It is difficult to set a definite limit upon the amount of steam required, but as a general thing it is seldom necessary to use more than 40 lb. of steam to get the desired results.

Cooling Water

In starting a new producer, the top plate has a tendency to run hot and will usually require about all the water that can be applied through the three connections furnished. After a few days the top plate becomes coated with carbon and the quantity of the water can

be considerably reduced. The overflow from the poker is usually sufficient for all purposes and this amounts to approximately 15 to 20 gal. per minute.

If for any cause the water pressure should be lost so that no water will flow through the poker, the producer should be immediately shut down and every effort made to keep the poker cool by means of an emergency line of steam or air. Caution should be exercised in starting the water flowing through the system, because if a large amount of cold water is allowed to strike the poker, there is danger of the point breaking, making its replacement necessary.

The life of a poker tip is from six months to a year, depending considerably upon the condition in which the operator has kept his fires. This tip is a separate point screwed into the main barrel of the poker while the latter is heated to a cherry red color. This method of applying new tips should be used to prevent their working loose under the action of the fire. It is good policy to have a spare poker and trunnion ready for immediate use and the entire poker and trunnion changed if it is necessary to make a replacement during the operating period. This operation should not require more than 20 minutes.

Shutting Down

In most installations there are periods when the furnace is down for repairs. This time should be taken to clean out the producer completely. The side walls should be cleaned, the blower and blast boxes cleaned out and any mechanical part needing attention should be repaired. This procedure, if carried out, will never entail a great deal of labor and this will be more than repaid by the increased reliability of the machine and the success attained in its use.

Industrial Tuberculosis

Industrial tuberculosis claims more lives annually than are killed in mine fires and boiler explosions, with railroad collisions thrown in. It is chiefly in the dusty trades that this enormous death toll is taken, according to data of the National Tuberculosis Association, received from health experts throughout the country. This organization, the leading agency in America to fight the white plague, is now engaged in a campaign against this menace, culminating in the Red Cross seal sale, by which its work throughout the year is largely financed.

"The country is facing a serious situation in its post-war period," says Dr. Charles J. Hatfield, managing director of the association. "This disease, we have found, claims no less than 150,000 lives a year. Also there are more than 1,000,000 persons in the United States who are suffering from active tuberculosis right now.

"A large percentage of this is industrial disease, and much industrial disease is preventable. Tuberculosis is caused by a germ which spreads from one person to another by spitting, direct contact, or other means. But the strong, healthy man does not have tuberculosis even when he gets the germ. The sound human body can resist it and throw it off. It is generally the man whose lungs have been injured by sharp bits of flying dust or whose general health has been injured by living or working in hot, stale air who falls a victim.

"That is why the dusty trades have so high a percentage of deaths from lung disease. All mineral products are as a rule subject to preliminary breaking or crushing processes, in connection with which a large amount of finely comminuted dust is produced, and this dust is likely to prove injurious to health."

Dr. Hatfield said no statistics are available to prove that pulmonary tuberculosis is excessively common among men employed in smelting and refining. The practical problem, he said, concerns the control of metallurgical smoke, which consists of three distinct substances—gases, flue dust and fume. Of these three it is only the flue dust that is of serious importance, consisting of small particles of the different ores, fluxes or fuel.

"The hygiene of smelting and refining is of extreme complexity," he said. "In the absence of an extended scientific inquiry into the subject at the present time definite conclusions cannot be made."

Dr. Hatfield called attention to a report prepared by Dr. A. J. Lanza, of the United States Public Health Service, dealing with the dust problem in industry. This, he said, sums up the medical viewpoint clearly and accurately, and is in part as follows:

"Dust is not a disease, but it is the cause of disease. Any hard, sharp rock dust when breathed into the lungs irritates and cuts them, making small scars. Besides, because of the constant irritation, the lungs become inflamed, and consumption is likely to develop. The constant irritation of the lungs weakens them and at the same time gives the seeds of consumption a good chance to grow. The dust breather is more likely to fall a victim to the careless spitter than the man whose lungs are sound. Working in dust, like exposure, is at times unavoidable, but a great deal if not most of the dust breathing is due to carelessness on the part of the miner himself, who does not realize the danger of so doing, or, if he does, is indifferent to it.

"The number of deaths from lung diseases among metal miners is much greater than among coal miners and is probably ten times greater than it ought to be. What can the miner do to avoid breathing dust? Water drills are being used more and more. In dry drilling with machines it is possible to lay the dust by water lines or by using a squirt gun and water from a bucket, but often men drill with the hole dry rather than turn on the water, because it spatters on them or makes the place sloppy. If you are drilling overhead and the water has to come back on you, wear a rubber hat and boots, and if necessary a rubber coat. This is a bother, but it is also a bother to observe all the rules of 'safety first' which save lives. A man working where there is much dust should wear a respirator if possible, and see that the respirator is in good condition. Respirators are clumsy and more or less of a nuisance, but it is better to wear one than to have consumption. Do not breathe hard-rock dust day after day, because if you do it will disable you in time. Men who can 'eat rock dust'—like the men who can 'breathe gas'—die young."

National Tuberculosis Association,
New York City.

The Booth Electric Rotating Furnace

BY CARL H. BOOTH*

AS A general rule, the quantity of non-ferrous metal melted at one time, or at one heat, is less than the quantities involved in the melting of steel and iron, and, therefore, smaller sizes of furnaces are desirable. To meet the requirements of the small foundry, as well as the large foundry, and the smelters and refiners, Booth furnaces are built in the following sizes:

Rated Holding Capacity	Maximum Holding Capacity
250 lb.	350 lb.
500 "	750 "
1000 "	1500 "
2000 "	2500 "
3000 "	4000 "

There are many small plants where heats of 50 to 350 lb. are required, and the smallest size furnace mentioned above answers the purpose with great economy, whereas larger furnaces, to operate efficiently, must produce more metal than is needed. Further, there is also a great disadvantage in trying to pour a ton of brass into small castings and keep the metal hot. We know of a large company which has a 1-ton electric furnace; it takes 50 min. to pour a heat into castings, and it is difficult to do it in that time. Also the great variety of mixtures made by many small foundries requires a small, efficient unit, from which "short" heats can be taken, producing great flexibility of operation.

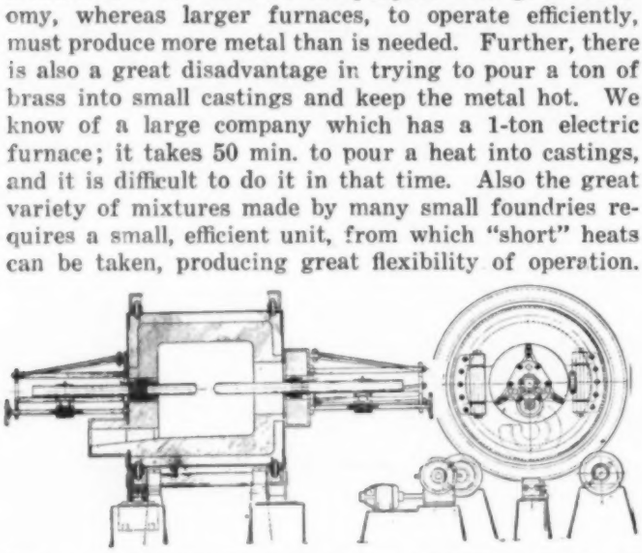


FIG. 1. CROSS-SECTION OF BOOTH ROTATING FURNACE

On the other hand, smelters and refiners frequently require furnaces of relatively large holding capacity, which will turn out a considerable amount of metal daily.

Fig. 1 is a cross-section or diagram, illustrating clearly the principle of construction of the Booth electric rotating furnace. As will be noted, the furnace revolves on rollers, and is carried by two cylindrical tracks. The rollers are driven at the proper speed by a motor, so as to rotate the shell at a speed of two revolutions per minute. No gearing is required on the tracks. The current is carried to the electrodes by means of short pieces of flexible cable, which connect to the above-mentioned track, and the current is supplied to the track by shoes which press against them and form a sliding contact. The electrodes are regulated by screws shown, and on small furnaces are entirely hand-operated, but on the larger furnaces automatic electrode control is used, thus doing away with the necessity of close watching on the part of the operator. In the small furnaces, the door is in one end only, but in the larger furnaces both ends are provided with a door.

Fig. 2 is a photograph of a rear view of a 250-lb. Booth electric brass furnace, in the foundry of Leitelt Bros, Chicago. This shows the charging door open ready for charging. The latch which holds the door shut when the furnace is charged will be noted and also the electrode projecting through the door. A door of similar type with electrode projecting through it has been in use a considerable period in the construction of the Booth-Hall steel melting furnace. The contact shoes are shown in this view pressing against the track.

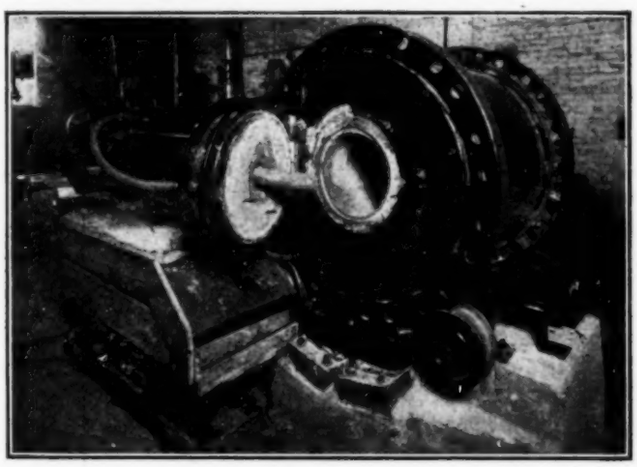


FIG. 2. REAR VIEW, SHOWING CHARGING DOOR

Fig. 3 shows the same end of the furnace after it is charged and the furnace is ready to run. The flexible cables from the track to the electrode holder are shown, as are also the water-cooling connections for cooling the electrodes. It is not necessary to open the door until after the heat is poured. The door is then opened for charging.

Fig. 4 shows a side view of the furnace. The cable supplying the power to the furnace is shown on both sides, coming from conduits in the floor to the bronze shoes. These are the only connections necessary to carry the electricity to and from the furnace. The operator is shown at the left regulating the flow of the current by means of a hand-wheel. The contactors are shown on the switchboard, together with push-button control for starting and stopping the furnace.

Probably the most important of all factors in reliable and efficient furnace operation is the lining. Especially is this true with the melting of non-ferrous metals, where a lining with many joints will have a decided tendency to absorb metal. In order to overcome this

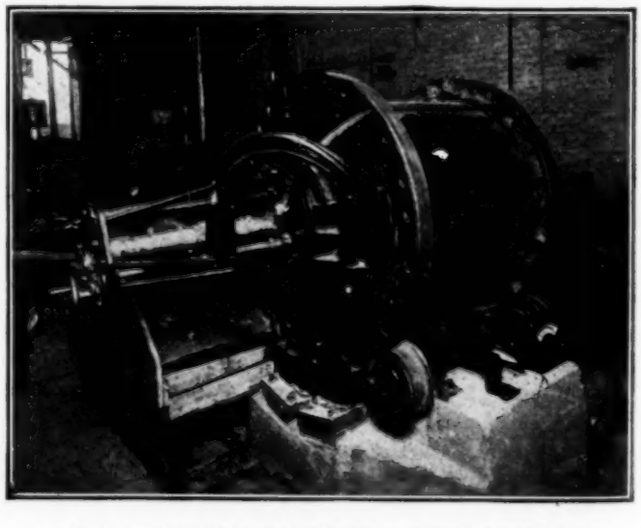


FIG. 3. CURRENT CABLES AND WATER-COOLING CONNECTIONS

*Extracts from paper delivered before A. I. C. E., June 18, Cambridge, Mass.

difficulty the lining provided with the Booth furnace is made with as few joints as possible.

In lining the furnace the electrode supporting mechanism at either end of the shell is removed by simply unbolting it from the end plates. These are made as a unit and in taking them off they do not get out of adjustment or out of line, and therefore do not require any adjusting when put back in place. The shell is then lifted off the rollers by suitable hoist or crane, just as if it were a barrel, and is turned on end so that the end plate of the furnace shown in Fig. 2 can be unbolted and removed from the shell.

Fig. 2 shows to some extent how this lining is made. The door is made of one solid piece of brick with a hole in the center through which the electrode projects. The cylindrical part of the furnace is made of two cylindrical tiles, which fit together with a tongue and groove joint in the center, this joint being filled with heat-resisting cement. The ends of the furnace are each lined up with four special bricks joined together with cement and cemented to the tiles. In this way we really have a large crucible electrically heated, but with walls of considerable thickness and a minimum number of joints. Further, this lining does not require a brick mason to install it, but can be put in with common labor. This special brick lining is backed up with a layer of heat-insulating material, so that when

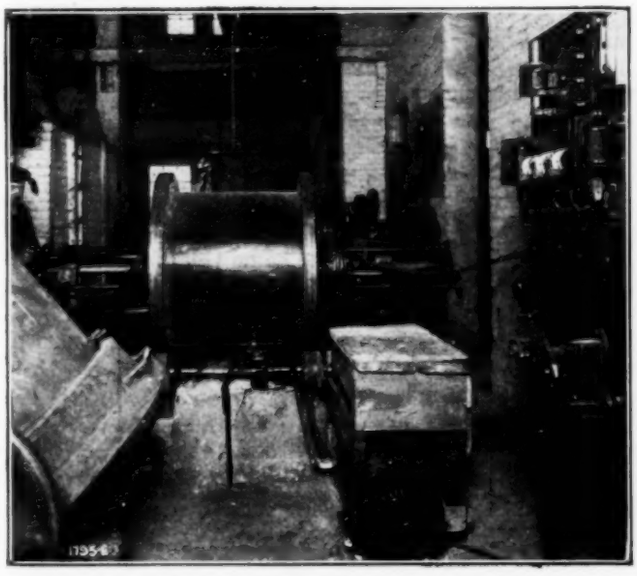


FIG. 4. MOTOR DRIVE AND SWITCHBOARD CONNECTIONS

the furnace is at working temperature, the temperature on the outside of the shell is so that the hand can be placed upon it. The time required for relining this furnace is 8 to 12 hours.

In melting down turnings, borings and grindings with a hot furnace, 30 to 40 min. is required per charge. With the small furnace shown the power consumption may be as low as 240 kw.-hr. per ton; the average would be between that and 300 kw.-hr. per ton.

With yellow brass turnings and borings which are fairly clean, but on which no attempt has been made to remove any contaminating material, heats have been run with a total shrink of 1½ per cent. These borings, when charged, were in the same condition as received from the seller. Of course the percentage of shrink will depend on the amount of oil, dirt, iron and other extraneous material present, but the actual metal loss has proved to be very low. Due to the active mixing action of the rotation, the heat is applied to the turnings and borings in such a uniform manner that there is no local overheating, and a quick melt with low metal loss is obtained.

In melting ingots and heavier brass scrap, a heat will average from 30 min. to 1 hr. in length of time, depending upon the kind of metal poured and the size of the charges. A 300-lb. charge of copper ingots requires about 1 hr. to melt and pour, while a 300-lb. charge of yellow brass requires about 40 min. The shrinkage with yellow brass ingots averages about 1 per cent and on red brass and high copper bronze under 1 per cent. With the furnace hot the power consumption will run from 250 to 350 kw.-hr. per ton.

One heat was made with a charge running about 50 per cent zinc and 40 per cent copper, totaling 250 lb.; 249 lb. of metal was poured and the power consumption was 240 kw.-hr. per ton. This was in the latter part of the day, when the furnace was hot, and the metal charged was all clean metal. The ladle was weighed as it was brought to the furnace, and then weighed after the metal had been poured into it. Great care was taken on the part of the operators not to overheat the metal, and this is simply an indication of what results are accomplished where sufficient attention is given to melting. The heat following was a charge of 225 lb. of red brass ingots, from which 224½ lb. of metal was poured.

With furnaces of this type the graphite electrode is to be preferred, due to its greater conductivity, which permits the use of the smallest size of electrode practical for the current to be carried.

The electrode-supporting mechanism has been so designed that it not only permits of adjustment in case electrodes are slightly out of line, but at the same time serves to protect the electrodes from breakage, due to the accidental falling of bars or other material against the end of the furnace.

Great difference of opinion still exists among operating engineers as to the proper power factor best to be used in connection with electric furnace loads. With small furnaces of the type just described, our judgment is that as low a power factor should be adopted as can safely be permitted with the conditions met with at the point of installation. This can be varied to suit different conditions by modifications in the design of the equipment. If a power factor as low as 70 per cent is permitted, the result will be that the furnace operator need not stay at the electrode hand wheel control to any great extent, but may be employed in getting his charge ready for the next heat, making suitable records and other miscellaneous duties. If, however, a higher power factor is required, the furnace can be readily operated, but will require more attention on the part of the operator unless automatic electrode regulators are provided.

It is our judgment that in case of installation of a battery of small furnaces, providing a sufficient advantage in power rate could be obtained by obtaining a higher power factor than 70 per cent, it would be best to install automatic electrode regulators. There would also be compensation in reduced labor cost due to the fact that one man could take care of a large number of furnaces under such conditions.

Simplicity.—In designing this furnace the aim has been to produce a furnace which was efficient enough so

that it could be built in small sizes suitable for adaption by the small brass foundry; at the same time such a furnace must be strong and rugged in construction, have few parts and be simple electrically, not requiring the supervision of an electrical engineer or other expert.

Flexibility.—Furnaces of this type can be built in large sizes and offer as many advantages to those plants requiring a large tonnage of brass as is true with a small foundry. The convenience of the operator has been particularly kept in mind, also the ease with which repairs can be made and of incorporating into the construction of the equipment all details which will eliminate shut-downs due to either mechanical or electrical details.

Economy in Handling.—The charging door of the furnace is located at the opposite point from the tapping. If a battery of furnaces is installed in a plant, it is much more convenient and economical both in the labor cost and in the handling of materials to have the charging operations carried on at one end of the furnace, entirely separate from the tapping and pouring. This also saves in floor space, as the furnaces can be located very close together under such arrangement.

Economy in Pouring.—In pouring the furnace the tap-hole is opened without coming in contact with the metal, and as the furnace is rotated by the motor, the metal pours out and can either be collected in ladles or be poured directly into molds or ingots brought up to the furnace by approved mechanical means. It is also entirely practicable to pick the furnace up off its rollers and carry it by suitable electric traveling crane over to the molds and pour directly into them. This method would be especially adapted for pouring ingot molds or the casting of slabs. After the furnace was poured it would then be returned and set on the rollers, charged and started in operation. Since there are no cables to be disconnected or other electrical connections made, this can be readily done.

Simplicity in Electrical Connections.—The absence of overhanging cables and the simplicity of the electrical connections is one of the great advantages of this furnace. This is readily apparent and is referred to again simply for emphasis.

Ease of Making Repairs.—Where a large number of Booth furnaces are installed in one plant it is advisable to purchase an extra furnace shell, which could be kept lined up ready for service. This will be particularly valuable in the case of a plant operating on 24-hr. basis, as it would save time in shut-downs. The method proposed would be: As soon as the lining of one of the furnaces in use was worn out, the furnace needing a new lining would be lifted off its rollers and the spare furnace set in place, immediately charged and started up without losing more than half an hour's time altogether. The furnace shell which was removed could then be allowed to cool down and new lining placed in it ready for further use.

Low Shrinkage Loss.—The important reason why electric furnaces are being adopted by plants melting brass is because of the large saving made in metallic shrinkage. The construction is especially noteworthy in this respect, and all advantages due to the movement of the metal are secured by the rotation

Freedom From Explosions Due to Gas Pressure.—Where mixtures are used which might result in the formation of much gas pressure in the furnace, the charging door or doors need not be luted up so as to permit of the escape of the gas pressure without blowing out the end of the furnace, as is understood to have been the case in a number of instances where sufficient openings have not been allowed. This can also be accomplished in a very simple manner by leaving the tap-hole open for a short time in case it is desired to burn off the oil and dirt prior to the melting of the charge. In other words, with a charge of turnings and borings which are dirty and oily, the furnace can be left stationary with the tap-hole open, the furnace being turned around on its rollers so that the tap is located at the top position instead of at the bottom, which would be the position in pouring. This open tap permits the burning oil and fumes to escape. As soon as the operator notes that metallic vapors are coming off, the tap can be plugged up with molding sand and the rotation of the furnace started.

Low Cost of Operation and Upkeep Charges.—The complete rotation of the furnace results in more even wear of the lining, a greater absorption of heat by the metal from it, which naturally results in an improved power consumption. These factors help to bring down the cost of melting and upkeep charges.

Since this type of furnace is new, and there has been only about a month's operation from which to obtain operating data, proof from actual records of just what the cost of these items will be is not at hand. The important fact remains, however, that the small furnace described in this paper was successful from the very first heat, has been in daily operation without shut-down from the time the power was first turned on, and the lining does not show any appreciable wear. It is expected that after a suitable length of time has elapsed the power consumption and other data obtained will show that there is a great advantage to be obtained in rotating the furnace completely.

Uniform Mixing of Charge.—The rotation of the furnace not only preserves the lining and secures a low power consumption, but at the same time serves to mix the metallic charge, making it more uniform without requiring much supplementary stirring. Except in the case of mixtures with high lead content, the rotation of the furnace will sufficiently mix the charge so that it is not necessary to stir it either in the furnace or in the ladle. This is quite an advantage and results in a more uniform product.

Standardization to Meet Prevailing Electrical Conditions.—In the past the construction of electric furnaces has been along lines which require the use of special electrical appliances and equipment. This furnace is a departure. It is entirely practical to operate it using the ordinary 110-volt single phase service which can be obtained from most public service companies.

Standardization of Mechanical Details.—All details of the furnace equipment are rapidly being standardized so that quick shipment can be made of furnaces, as they are shipped completely assembled and the production and installation is a simple matter. In case automatic electrode regulator control is desirable, it should be pointed out that only one regulator would be required, and this would reduce the investment cost materially.

Furnace Can Be Designed to Operate 3-Phase.—In the design of large size furnaces of this type, we have plans perfected for completing the equipment so that it can be operated using either 2 or 3 phase alternating current instead of single phase. This would be important in many cases where public service companies are not in position to handle single phase loads over 75 k.v.a.

The Vicious Postal-Zone Law

BY ARTHUR CAPPER
United States Senator from Kansas

IT HAS been argued that the postal-zone increases apply only to the advertising sections of magazines. This is perfectly true as a statement of the mere words of the postal-zone law.

It is not true as a statement of facts.

For a periodical or a newspaper is a unit from cover to cover. It is one unit of bulk that is never broken. The argument that the increased postage merely affects advertising is virtually the same as if it were argued that the postal-zone legislation had provided that the upper half of a magazine should pay postal-zone rates and the lower half flat rates. It would be a mere bookkeeping separation that would not in the least affect the postage cost to the reader, for the reader—who is the ultimate consumer—takes the magazine as it comes, and the cost of the magazine is its cost as a unit, and its postage cost to him is its entire cost as a unit, no matter how ingeniously or intricately one may subdivide the component parts.

There is one other important factor also, which I feel many sincere and ordinarily keen-minded citizens have overlooked, and that is, that the magazine and newspaper differ from every other commodity—if you wish to consider newspapers and magazines as merely commodities—in the fact that it is the only "commodity" that is sold to the consumer at less than its actual cost of manufacture!

And a newspaper or magazine is the only "commodity" of which this is true.

Now as to the advertising and whether it should pay a higher rate than the body of the magazine. I think I have answered half of that question when I point out that the periodical and newspaper are the only products that are sold for less than their cost of manufacture, and that this fact is made possible by the advertising. Advertising is nothing but a bulletin board—the bulletin board of our economic, wealth-producing, business life.

Advertising is the one great factor in modern wealth production that enables wealth to be distributed almost instantaneously; a generation or so ago the same result could not have been accomplished without years of hand-to-hand selling and expensive, slow, personal salesmanship. You, as a thinking citizen, know what any restriction upon advertising would do to the wealth production of this nation. Congress itself saw this, and when means of war taxation were being carefully discussed and every channel was being developed, it was deliberately decided that the destructive economic effects that would follow the taxation of advertising would be too great and too dangerous to attempt.

Now then, as to the allegations of the cost of transmission of this second-class matter through the mails.

The figures upon which the absurd allegations of second-class deficits are made were compiled by the Post Office Department in 1908 and 1909—eleven years ago! So unreliable were they even then that when the U. S. Postal Commission, headed by the Hon. Charles E. Hughes, investigated them two years after their compilation, they were officially discredited as being no indication of what the costs were for the various divisions of second-class matter! Moreover, the Post Office Department since that date has taken pride in stating that it has in enormous and basic ways cheapened the postal cost of second-class matter.

The most unfortunate part of this postal-zone legislation is that it is an insidious and dangerous attempt to set back postal history seventy years and re-establish the universally condemned principle of postal cost determining the postal rates. It abolishes the sound postal principle of equal postage to all parts of our nation. The rural free delivery—one of the most vital and important postal functions—is conducted at almost a total loss, and if this vicious and unsound cost principle is once established the demoralization of our splendid postal principles is only a matter of logic and time.

Who Are Entitled to Compensation

BY CHESLA C. SHERLOCK

EMPLOYERS are often puzzled to understand the meaning of the compensation acts, especially as they apply to the coverage of workmen within their employ. They are surprised, for instance, to discover that many workmen within their employ are not entitled to the benefits of this legislation, and many other employers are greatly agitated when they discover that they have been paying a premium for the risk of employees who are not and should not be considered as risks under the workmen's compensation acts.

Generally speaking, the purpose of the compensation acts is to provide compensation for those workmen who are injured as the result of an accident "arising out of and in the course of" the employment. This necessarily excludes a good many workmen who receive injuries by accident that do not arise out of and in the course of the employment, but it does not relieve the employer of the necessity of carrying them under an insurance policy as a risk for the reason that they doubtless are the character of employees who are likely to be injured in a compensable accident and be entitled to the benefits of the law at any time.

Instances where workmen are not entitled to compensation even though injured by accident may be mentioned briefly. If a workman is injured while on his way to or from work, he is not entitled to compensation, as the courts do not deem that the injury arose out of and in the course of the employment. If he is injured as a result of horse play or malicious intent of another to inflict bodily hurt upon him, he is not generally entitled to compensation. If the injury is due to his own willful misconduct he is likewise not entitled to the benefits of the workmen's compensation acts.

CERTAIN CLASSES EXPRESSLY EXCLUDED

There are certain classes of workmen, however, who are never entitled to compensation and they are expressly excluded from the benefits of the law by the statute itself. Yet employers go on year after year laboring under the false impression that it is necessary to include them in their list of risks and keep on paying premiums upon such risk, when they are plainly merely putting the money in a hole in the ground.

In the first place, every employer should procure a copy of his State statute and find out just what class of employees is included in the coverage of his law, and pay insurance premiums only on those risks which are

entitled to compensation in case of injury under compensable circumstances.

In some States he will find that only those who are engaged in a hazardous occupation are entitled to compensation if injured. In many shops and factories this will materially lessen the number of risks which the employer has to carry.

For instance, all clerks and clerical help of whatsoever nature are not covered under the expression "hazardous occupation." The courts have held this repeatedly, yet I personally know many employers who habitually paid premiums on the risk of these employees because they thought they would be entitled to compensation in case of injury.

Casual Employees Generally Not Entitled to Compensation

Casual employees are not generally entitled to compensation. This generally includes all odd-job labor, such as window washing. The point to be kept in mind is that it is the character of the work being done that determines the element of liability and not the character of the employee. A man may be a casual employee and be engaged in a compensable occupation. He would not, of course, if hired for one job as a casual employee, be entitled to compensation if injured, but he may be a regular employee who is engaged in casual employment at the time of the injury. Some courts have said that even he is not entitled to compensation because it is the nature of the work being done that determines the test of liability.

In instances where the work is exceedingly dangerous and the employer has formulated strict rules as to the way in which the work has to be done, and enforces those rules in case of violation by the discharge of the offender, a subsequent disregard of such rules by an employee resulting in injury to himself will relieve the employer of liability, as the workman is deemed to have been guilty of misconduct such as to deprive him of his rights under the law.

Employees engaged in domestic service or those engaged in agricultural pursuits of any nature, even though working constantly with farm machinery, are not covered under the compensation acts, unless by express wording.

Gardeners and lawn keepers around factory premises then are not entitled to compensation. Those who work even at hazardous occupations, if it be an "agricultural pursuit," are not covered unless the statute expressly says so.

Independent Contractors Not Covered

Workmen who are working as independent contractors are not covered by the compensation acts and no premium need be paid on their risk. This does not necessarily exclude all time and piece laborers, but it does exclude all those who are taking work to do wherein the employer has no control as to the means in which the work is done, having control merely as to the general result of their labor. In such cases the court deems these employees to be independent contractors and relieves the employer of liability in case they are injured while at work.

If the workman is engaged in work outside the usual course of the trade and business of the employer, he is not entitled to compensation under the compensation acts.

All those who stand in a representative capacity or who are executives in the business are not workmen within the sense of the compensation acts and cannot recover compensation no matter how hazardous their work may be. A case is recalled where a faithful bench worker was made a vice-president in the company in order to "fill out" the list of officers and as a reward for long and faithful service. Upon injury, he was denied compensation.

Employers by paying premiums only where they are needed and in carefully checking over their lists from time to time can save themselves and their companies a great deal of premium money that is otherwise being wasted. And there is a surprising lot of it in some quarters due to a failure properly to understand the compensation laws.

House Considers Tariff on Graphite

Despite the discouraging prospects of obtaining action by the Senate, the Committee on Ways and Means of the House of Representatives has held two hearings on a bill placing duties on imports of graphite. Strong protests against any tariff were made before the committee by crucible manufacturers and other consumers of imported graphite.

The bill which was before the Ways and Means Committee provides a duty of 2c. a lb. on all imported amorphous graphite; 3c. a lb. on all crystalline, lump, chip, and all crystalline graphite which will not pass through a ¼-in. mesh; 6c. a lb. on all crystalline graphite that will pass through a ¼-in. mesh.

The first rate of duty mentioned affects principally the graphites imported from Mexico and from Korea. The second rate applies more particularly to the better grade of Ceylon graphite, while the last named rate affects Madagascar and Canadian flake and Ceylon dust. Practically all Canadian graphite and probably that of Madagascar flake would be excluded from importation by the bill, it is admitted.

Substitution of the electric furnace for crucibles would be forced by the bill, according to Malcolm McNaughton, the chief chemist of the Joseph Dixon Crucible Co., who testified before the committee. As a consequence, he argued, producers of domestic graphite are injuring their own interests in urging the passage of the bill, as they are likely to destroy the principal market for their product.

A. B. Conklin, who appeared in behalf of the Alabama graphite industry, does not share the view of Mr. McNaughton, and insists that it is in the interest of the American people as a whole to have developed this country's supplies of graphite, which he contends can be used just as successfully as the foreign product if manufacturers will undertake sympathetically to make slight changes in their practice.

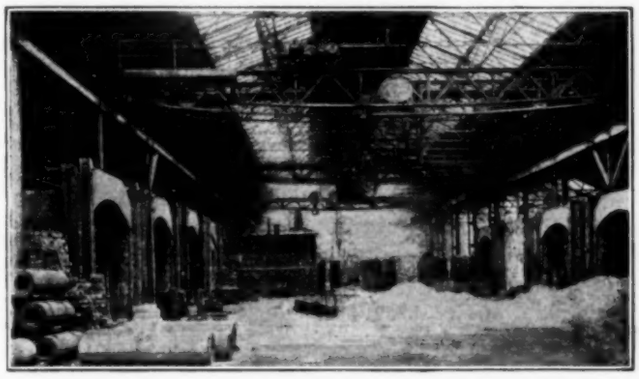
A plea that stocks of graphite purchased abroad by America and which cannot be moved because of lack of shipping should be exempt from the duty imposed in the bill was made by Charles Pettinos, a New York dealer in both foreign and domestic graphite.

Fundamental data concerning the amount of graphite produced in this country as well as the amount imported were presented to the committee by George Otis Smith, the director of the United States Geological Survey. Mr. Smith also gave a detailed description of the uses to which the various classes of graphite are put in industry.

Synopsis of Recent Chemical and Metallurgical Literature

British Electrodes

Prior to the war, the consumption of electrodes in Great Britain was rather meager, and that little easily supplied by America, Sweden and Germany. By 1915,



VIEW OF MAIN BAY, ELECTRODE CO. OF SHEFFIELD

the Electrode Co. of Sheffield, Ltd., was organized, and built works at Meadow Hall for a capacity of 2500 tons per annum of amorphous carbons. Experimentation has gone forward continuously with production, however, and at present the company is engaged in extensive additions following ideas developed in the last year or so, which will increase its production to 7000 tons yearly.

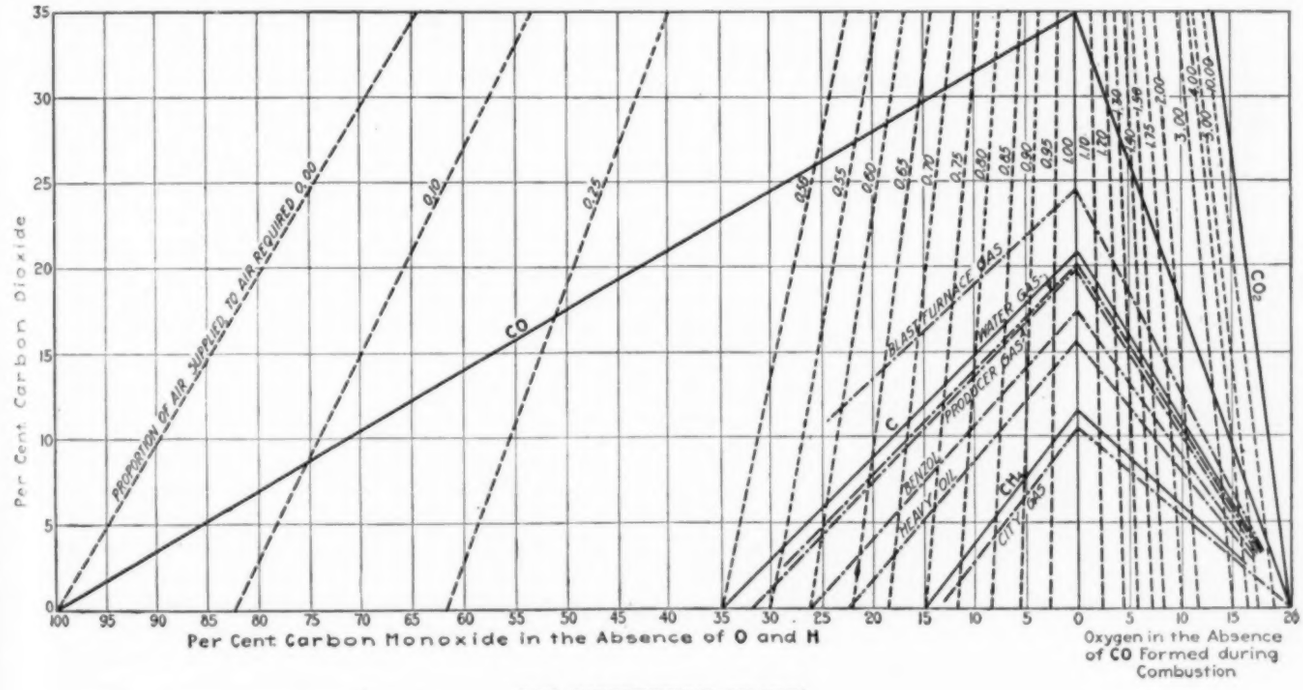
The company's main building, some 320 by 100 ft. in area, is served by three 5-ton traveling cranes, as is shown in the accompanying illustration, taken from the *Iron and Coal Trades Review*. Raw anthracite is first burned in muffle- or retort-type furnaces, and then delivered to a storehouse containing also scrap electrode and retort carbon stock. These materials are then crushed, elevated, and ground in a Newell ball mill, the discharge being carefully graded. Mixing is effected in a battery of four steam-jacketed runner mills, each driven by a 45-hp. motor.

Molding is done in a pit immediately below the runner mills; the molds themselves are first dipped in heated oil, and rammed full of the carbonaceous mixture by a portable tamper. A crane then delivers the filled molds to the press plant, comprising two hydraulic presses of 500 and three of 300 tons capacity, each with a separate water and pumping system. After pressing, the molds are stripped by a further stroke of the press, stood on end to dry, and finally burned in a battery of ten coal-fired furnaces, the time required being about three weeks.

Gas Combustion Chart.—At the July, 1919, meeting of the Société Technique du Gaz, Mr. GREBEL presented an important contribution on the influence of the burner on the efficiency of industrial heating by gas.[1] He also gave the chart shown herewith, by which one can determine the influence of the percentage of air on the thermic potential of gas heating and of the specific consumption of the burners. The chart applies to the combustion of fuels composed of hydrogen, carbon and oxygen with an excess or deficiency of air. The oblique dash lines giving the proportions of air supplied to air required were determined on the assumption that all the carbon dioxide results from combustion and the nitrogen from the air supplied. The pure combustibles, methane, carbon, carbon monoxide, are represented by the full lines and hydrogen by the bottom horizontal line; the complex fuels, city gas, heavy oil, benzol, producer gas, water gas and blast-furnace gas, are represented by the dot and dash lines. The part at the right of the zero vertical line is for excess of air and the part at the left for deficiency in air.

From the analysis of the gases of combustion by an Orsat apparatus, it is easy to determine by the chart the quantity of air furnished and utilized, and the quantity of air necessary for perfect combustion.

[1] *Le Génie civil*, Aug. 16, 1919, pp 152-154.



GAS COMBUSTION CHART

Recent Chemical and Metallurgical Patents

Complete specifications of any United States patents may be obtained by remitting 10c. each to the Commissioner of Patents, Washington, D. C.

Smelting Process and Apparatus.—F. H. FRANKLIN HAMPTON of Sewell, Rancaqua, Chile, has devised an apparatus with which it is possible to smelt flotation concentrate or finely pulverized ore continuously without the necessity of briquetting the concentrate or ore. Pulverized coal or oil is used as fuel. The apparatus is shown in vertical section in Fig. 1, Fig 2 is a horizontal section along line *B-B* of Fig. 1, and Fig. 3 is a fragmentary vertical radial section taken along line *C-C* of Fig. 2. The pulverized ore and fuel are blown into the smelting chamber (*a*) through the vertical tuyere (*c*). The proportions of air, fuel and charge are so adjusted that complete combustion of the fuel will result from the combined oxidizing effect of the air and the charge. The ore is

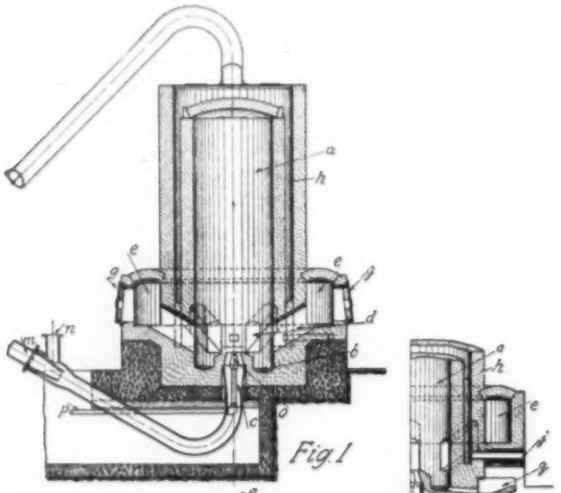


Fig. 1

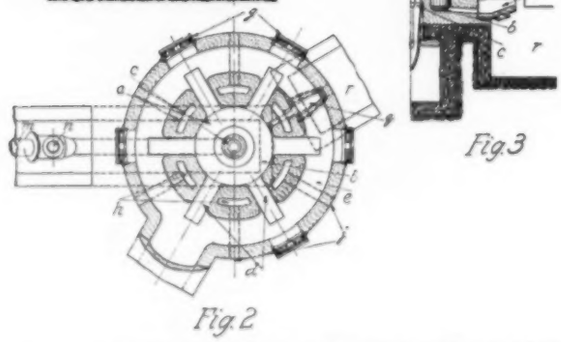


Fig. 2

Fig. 3

fed in at (*n*) and the pulverizing coal and air blast at (*m*). If oil is used as fuel it is fed through pipe (*p*) and nozzle (*o*). The air blast is heated to about 500 deg. C. by being drawn through ducts (*j*) and heating jackets (*h*). The reactions which take place are similar to those taking place in the ordinary blast-furnace in that the resulting products are a slag and a matte, which collect in hearth (*b*) and are then tapped through spout (*q*) to the forehearth (*r*), Fig. 3. The products of combustion pass through the flues (*d*) and (*e*) to a stack. (1,315,551, Sept. 9, 1919; assigned one-half to W. W. Stenning of London, England.)

Process of Recovering Platinum Metals—WILLIAM C. FERGUSON of Garden City, N. Y., treats electrolytic copper slimes for the recovery of metals as follows: Roast in the presence of sulphatizing agent; then leach with water, thereby dissolving copper and silver sulphates; the residue is lixiviated with diluted sulphuric acid and the dissolved silver subsequently precipitated as chloride. The insoluble residue from these operations, containing gold, silver, platinum, palladium, tellurium and traces of copper and lead, is treated with aqua regia. Gold is dissolved and subsequently separated from solution by precipitation with ferrous sulphate. The insoluble silver in the residue is recovered by solution in sodium thiosulphate, the residue being returned to the smelter. The acid solution, which contains practically all the platinum and palladium from the original slime, also antimony, tellurium and traces of gold, lead and copper, is saturated with sulphur dioxide and heated to about 200 deg. F. until tellurium precipitates in appreciable quantities. All the platinum, palladium and some cuprous chloride are thus precipitated. This precipitate is separated by filtration, treated with concentrated sulphuric acid, heated until the acid fumes, the tellurium compound present is decomposed and the volatile portion thereof expelled from solution. Crystals of sodium nitrate are added to the hot solution, thereby oxidizing the tellurium and dissolving the palladium. This solution is diluted and filtered, and the contained palladium precipitated by ferrous sulphate substantially free from tellurium and copper, but containing traces of gold and platinum. The residue from the sulphuric acid treatment, containing the platinum and some gold, is dissolved with aqua regia, and the solution is then saturated with ammonium chloride. Ammonium platinic chloride is precipitated and removed by filtration, the filtrate being returned to an earlier stage of the process. Metallic platinum is obtained by reduction of the ammonium platinic chloride. (1,315,660, Sept. 9, 1919; assigned to Nichols Copper Co. of New York.)

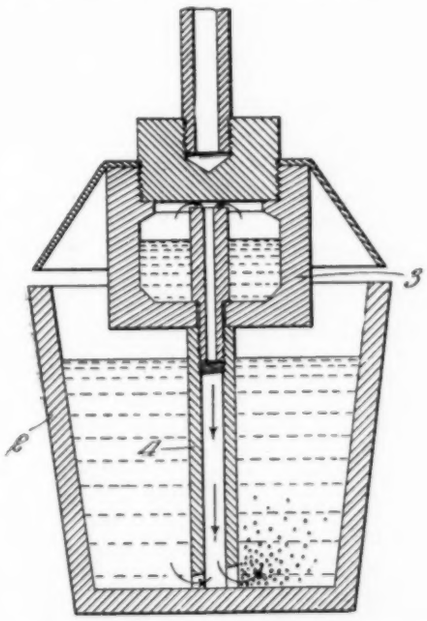
Art of Melting Metals—WILLIAM H. BRISTOL of Waterbury, Conn., patents a process for preventing the oxidization of metals when these are melted in a crucible, electric resistance or other suitable furnace, which consists of providing over the surface of the metal an envelope of steam. In an electric-resistance furnace the steam also prevents the oxidization of the resistor. (1,315,206, Sept. 9, 1919; assigned to the Bristol Co., of Waterbury, Conn.)

Process for Treating Copper Ores by Sulphatization and Flotation.—NIELS C. CHRISTENSEN of Salt Lake City, Utah, has devised a means of recovering copper from oxidized ores or from sulphide ores that are partly oxidized. The process consists of treating the moist pulverized ore, in the absence of air, with sulphur dioxide gas which is free from sulphur trioxide at a temperature somewhat below the boiling point of water. The reaction under these conditions results in the production of cupro-cupric sulphite and cupric sulphate. This reaction is carried far enough to coat the surface of the mineral particles. The cupric sulphate is precipitated in the diluted pulp by the addition of $CaCO_3$ and the pulp treated in any type of flotation machine for the recovery of the copper. (1,316,352, Sept. 6, 1919; assigned to Metallurgic Improvement Corporation of Salt Lake City.)

Process for Treating Ores and Concentrates.—MELVILLE F. COOLBAUGH of Golden, Colo., has devel-

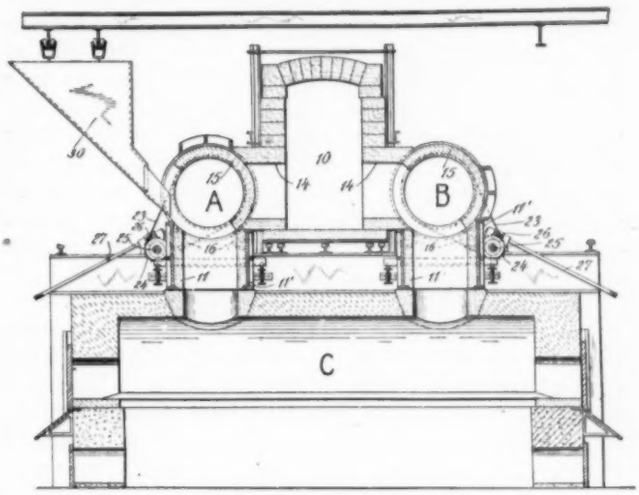
oped a process for the treatment of ores or concentrates containing gold, silver, copper, lead, iron and zinc, for the separation and recovery of these metals. The ores or concentrates containing sulphides are roasted, thereby changing copper, lead, iron and zinc compounds to oxides. Gold and silver either remain unchanged or are changed to metals. The roasted minerals are discharged into another furnace and brought into contact with the hot gaseous products from the first furnace which contain sulphur dioxide. This furnace is maintained at a temperature between 450 and 850 deg. C. Under these conditions, the oxides of zinc, copper and lead and any silver present as chloride are changed into sulphates. Iron oxide, metallic gold and silver remain unaffected. The product is treated with water, the sulphates of zinc, copper and silver being dissolved and the solution electolyzed for the recovery of the copper and silver. The zinc solution is purified and electrolyzed for the recovery of zinc. The insoluble residue from the water leach containing lead sulphate, iron oxide and metallic gold and silver is smelted for the recovery of gold, silver and lead. (1,315,761, Sept. 9, 1919; assigned one-half to J. Burns Read of Vermilion, S. D.)

Admixture of Metals or Substances for Alloy—EDMUND GODFREY BURR of Montreal, Canada, has devised an apparatus whereby an alloy can be conveniently made in which one of the constituents of the alloy is volatile at the temperature of the melting point of the other constituent. The apparatus con-



sists of the crucible (2) and the retort (3). The metal of the higher melting point is contained in the crucible and the volatile substance is contained in the retort. The whole apparatus is placed in the furnace and the volatile substance is driven down through the center shaft (4) into the molten metal. This method allows for intimate mixture and produces a uniform alloy. (1,315,208, Sept. 9, 1919.)

Metallurgical Furnace.—WALTER O. BORCHERDT of Austinville, Va., has designed a rotatable valve or damper for the flue system of a zinc-roasting furnace. This valve in the position as shown at (*A*) in the figure permits charging of ore or fuel through chute (30) or connects flue (11) with the atmosphere; in position shown at (*B*) the valve connects flue (11) with flue (14) and thereby with main flue (10). In an intermediate position air can be admitted from



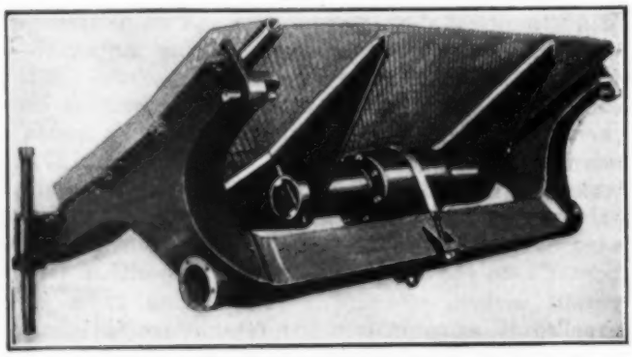
without the furnace through flue (14). The valve (15) is cylindrical, is made of refractory brick, and consists of a cylindrical shell, and circular end enclosures. The valve rotates on the end flange, being supported by rollers (16). The valve is rotated by chain (23) at each end which is bolted to end flange, motion being carried by sprockets (24) on shaft (25) by means of worm and nut shown at (26) through shaft (27), to which is attached a hand wheel. The functions of the valve are as follows: In position (*B*) to allow the passage of volatile products from the combination chamber (*C*) to the main flue (10). In position (*A*) to permit carbon, soot and (or) reducing gases to be expelled to atmosphere from freshly ignited charges, thus making practical the use of coal which would be otherwise unsuitable, because soot would blacken the oxide, and the carbon and reducing gases would interfere with the oxidization of zinc to zinc oxide. Also to expel to the atmosphere volatile metals such as cadmium and any water vapor that may be formed. Finally, to permit charging into the combustion chamber of the furnace, and at the same time prevent the entrance of air, gases and dust into the main flue. In an intermediate position a regulated amount of air may be admitted to the main flue. (1,316,267, Sept. 6, 1919; assigned to New Jersey Zinc Co.)

Electrolytic Process.—WILLIAM E. GREENAWALT of Denver, Colo., introduces sulphur dioxide into an electrolytic tank during the electrolysis of impure copper sulphate solutions containing ferric sulphate. This ferric sulphate is reduced to ferrous sulphate, thereby increasing current efficiency, producing sulphuric acid and preventing the formation of copper sulphate at the cathode as the result of the reaction of ferric sulphate on metallic copper. The reduction of polarization lengthens the life of the insoluble anodes. The effectiveness of the process depends on the thorough association of the sulphur dioxide and the electrolyte, which is accomplished in the apparatus. A stirrer is located between the cathodes and the anodes. The gas and the electrolyte are brought into intimate contact by mechanical agitation in an auxiliary tank. (1,314,742, Sept. 2, 1919.)

The Mitchell Screen

THE Mitchell electric vibrating screen has been perfected during the last two years by Mr. B. A. Mitchell at the plant of the Utah Copper Co., Garfield, Utah. An upward rotary motion is imparted to the screen by means of an electric motor mounted eccentrically, with the result that 3600 revolutions per minute are obtained. The motor is protected from dust by the tubular casing *A*. The larger cross section at center encloses the driving motor (*B*), the smaller cross sections at either end enclose the ring oiling bearings (*C*) and the ball cages (*D*). The casing itself is cast in two sections which are rigidly bolted together by means of bolts (*E*), clamping securely the motor stator between the inside faces of the casing.

The mechanism is held firmly to the main screen frame by means of a steel strap (*F*) which encircles the middle circumference of the casing. The mechanism rests at its contact with the screen frame in a ball and socket joint (*G*), the convex portion attached to the vibrator and the concave portion attached to the screen frame. By means of this strap and joint the whole mechanism is free to move in any direction about this joint (*G*) as a center.



UNDER VIEW OF SCREEN AND MOTOR

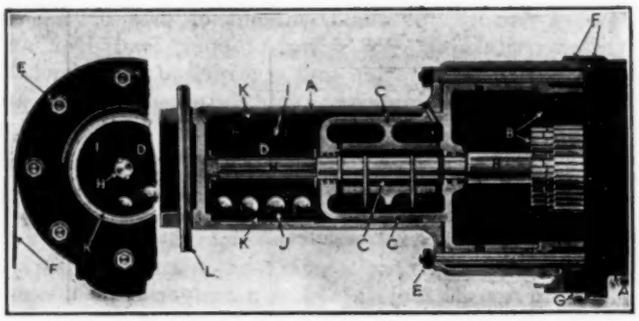
A long shaft (*H*) runs through the center of the machine and is supported by the ring oiling bearings (*C*). At the center of the shaft is keyed the rotor (*B*) and at each end of the shaft (*H*) is keyed the hard fiber cylindrical ball cage (*D*), having radial bored round holes (*I*) slightly larger than the diameter of the balls (*J*) arranged as shown in section at left of drawing.

Encircling the fiber ball cage and pressed tightly into the tubular casing (*A*) are the hard steel ball races (*K*). In operation one or two adjacent rows of holes are filled with balls in the ball cage at each end of the shaft (*H*). Any particular row of balls at one end of the shaft is counterbalanced by a similar row of balls at the other end of the shaft, but the two rows are 180 deg. apart with reference to the circumference of the shaft.

When the ball cage is rotated by the motor, centrifugal force causes the balls to travel to the inside periphery of their respective races with such force that gravity is reduced, and the mechanism being free to rotate at its center, at the ball and socket joint, an eccentric motion is produced at either end of the mechanism.

This motion may be roughly illustrated by taking hold of a pencil at its center by the thumb and first finger of one hand, and with the other hand moving one end of the pencil in a slightly circular path.

The vibrating motion of the mechanism is positive



CROSS-SECTION OF ROTATING MECHANISM

and is at its maximum at the ends, diminishing to practically zero at the center of vibration. The operation is very quiet. By varying the number of rows of balls or number of balls in a row in the ball cage at each end of the shaft, the strength of vibration can be accurately regulated. The vibrating motion is that of a compound or double conical pendulum acting on a horizontal axis.

It is in the production of this motion that lies the revolutionary character of the Mitchell screen and that accounts for its superiority. By it the upward drive of mesh against screening material is made possible, supplemented by the backward tossing that does so much toward thoroughly segregating the material.

The Stimpson Equipment Co. of Salt Lake City is the manufacturing agent.

New Type of Direct-Current Motors and Generators

In a type of commutating pole direct-current motors and generators known as type E, which has just been introduced by the Allis-Chalmers Manufacturing Co., the machines are not only rugged and compact, with excellent operating characteristics, but the many details which contribute to accessibility, reliability and safety have been thoroughly worked out.

This line includes the following standard ratings:

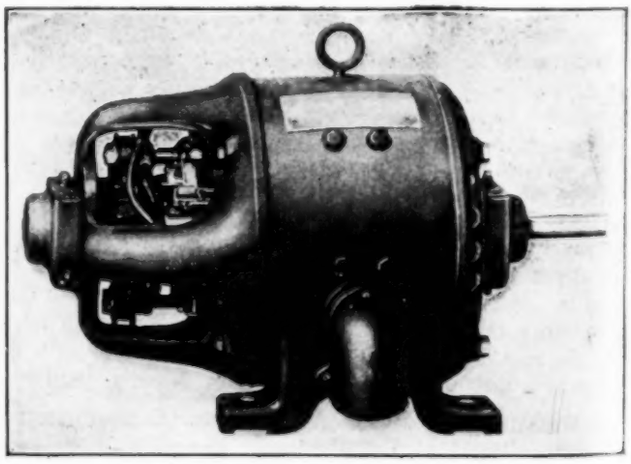
Continuous rated (50 deg. C. rise) motors, for applications where the power requirements are definitely known.

Normal rated (40 deg. C. rise) general purpose motors.

Adjustable speed motors for continuous or intermittent service.

Generators and exciters.

For constant speed motors the ratings and speeds are the same as those of 60-cycle induction motors,



25-HP. MOTOR WITH GRID REMOVED

and they can thus be used interchangeably with induction motors for direct-connected applications without changing the method of drive or the ratio of gearing.

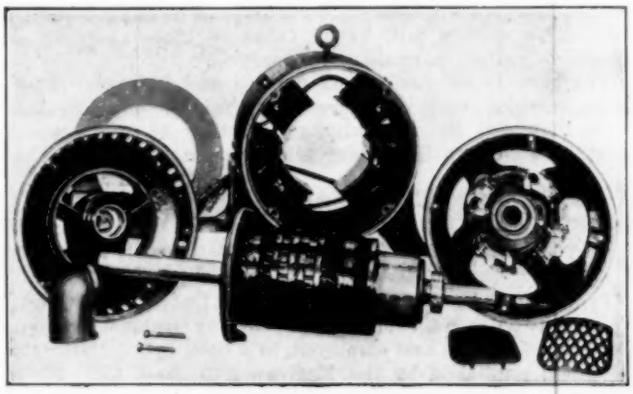
Adjustable speed motors, intended particularly for machine tool and similar applications, are provided for 2:1, 3:1 or 4:1 speed range. Generator speeds also correspond to those of induction motors, thus permitting the direct coupling of the machines to form motor-generator sets in various combinations.

The line of ratings now complete covers motors from ½ to 50 hp. and generators from ½ to 40 kw., while larger sizes are under development.

Cast steel yokes, combining light weight and rigid construction, are used for the larger ratings, while the smaller machines, which are of the bi-polar type, have riveted frames.

The accessibility of the commutator is apparent from the photographs. Protecting grid covers can be provided for these openings in the front bearing bracket; they are readily attached and may be applied even to machines in service, without affecting the rating. Solid covers are used with completely inclosed motors, the rating of these machines being somewhat lower than open or semi-inclosed motors.

All machines have ring-oiling, dust-proof bearings,



TYPE "E" MOTOR DISMANTLED, 25 HP., 230 V., 1150 R.P.M.

while the windings are treated to resist oil and moisture. Conduit terminal boxes, regularly supplied, have removable covers, giving ready access to the terminals. Box type brush holders are adjustable for tension and suitable for either direction of rotation. Each holder can be removed independently with a screwdriver

The field coils are wound on metal spools, which prevent any movement of the coils, and are protected by an outside layer of enameled wire. The armature core has the laminations riveted together, permitting the removal of the shaft without dismantling the core or commutator, while with ratings of 20 hp., 850 r.p.m. and larger the core and commutator are built on a sleeve, so that the shaft can be pressed out of the finished armature without disturbing the windings.

An important feature of the machine is the very thorough ventilating system which has been provided, the air being drawn out by the fan mounted on the rear armature head; fresh cool air flows in through the liberal ventilating ducts and takes up the heat from the iron and windings. This heated air is forced out through openings in the periphery of the rear bearing bracket. With thorough ventilation the internal temperatures are kept low, thus greatly prolonging the life of the insulation.

Tin-Plate Manufacture in Japan

In Japan the demand for tin plate is continually increasing. The manufacture, however, cannot be pursued profitably in this country. Most of the imports come from America. In 1916 about 65,000 lb. were imported, but thereafter the annual shipments were reduced to 40,000 or 45,000 tons, owing to the war. Since the proclamation of the armistice imports have been showing a slight increase, but are not sufficient to satisfy the demand in this country. It is reported, according to the *Japan Chronicle*, that the Yawata State Steelworks in Kyushu have for some time past been carrying on experimental work in the manufacture of tin plate, and the results are so promising that commercial manufacture is soon to be started and the product put on the market.

Book Reviews

TIMBER; ITS STRENGTH, SEASONING, AND GRADING. By *Harold S. Betts.* 234 pages, 8 inserts of tables and maps, illus. New York: McGraw-Hill Book Co., Inc.

This book is intended for engineers, manufacturers and users of lumber and fills a long felt want for a comprehensive reference volume on wood construction in the engineering field. Coming as it does from the pen of a writer immersed in the many phases of timber research at the Forest Products Laboratory, the large amount of data presented bears the stamp of highest authenticity. The short introductory chapter on resources of the United States presents in a concise manner the source of timber supply as it exists today, clarifying a situation which to many has hitherto been rather vague. The chapters on structural properties of wood, effect of moisture and the strength of wooden products cover the field of wood construction. A wealth of usable information is given in exhaustive tables, together with methods of testing the strengths of various timbers. Detailed applications of species in telephone poles and crossarms, vehicle manufacture, packing containers, and structural parts are entered into. Many engineers are cognizant of the fact that life is added to the structure by employing seasoned wood, but few realize that kiln-dried timber is really essential to economical construction. Large savings may be effected by care of the lumber pile in storage. These features, with all the refinements of operation, are given in a chapter on the seasoning of wood. The grading of lumber by the manufacturers' associations acquaints the reader with the vernacular of the industry, and the final pages on the national lumber production detail the commercial aspects. The book is well illustrated, the diagrams and tables are largely extracted from official government data, and the text is such as appeals to the professional engineer. It is a handbook for the engineer.

CHESTER H. JONES.

* * *

HANDBOOK OF CHEMISTRY AND PHYSICS. Compiled by *Charles D. Hodgman.* 554 pages, flexible pocket size, seventh edition, 1918. Cleveland, Ohio: The Chemical Rubber Co.

The author was assisted in the preparation of this book by Melville F. Coolbaugh and Cornelius E. Senseman. The latter contributed the chief features of this edition in the form of an enlarged table of physical constants of organic compounds, occupying over 100 pages and listing over 2000 compounds. Many of these substances which have only recently become important are listed together with the more common alkaloids and salts. The necessary properties are tabulated for each compound.

The work is intended as a portable reference volume for use in the laboratory and field, and aptly combines the physical and chemical data necessary for practical reference.

The general chemical tables, properties of matter, heat, hydrometric and barometric tables, sound, electricity and magnetism, light and miscellaneous physical tables include a wealth of detail sufficient for ordinary purposes without becoming an exhaustive library and are supplemented by the usual mathematical tables, measures and units usually found in the engineers' handbooks.

No space is wasted on educational explanations, the result being a concise handbook for chemists and chemical engineers. As compared with previous editions the present one exhibits a marked improvement. It is the history of engineering handbooks in general that several editions are required to eliminate errors. The authors are to be congratulated on the present development.

CHESTER H. JONES.

* * *

DIRECTORY OF THE CHEMICAL INDUSTRIES IN CANADA.

The Dominion Bureau of Statistics, Census of Industry Division, Canadian Government, Ottawa, Canada, has issued a Directory of the Chemical Industries of Canada, as of date Jan. 1, 1919, for general distribution. The statistics were prepared at the request of the Honorary Advisory Council for Scientific and Industrial Research. This directory represents the results of the first part of a survey which was undertaken (1) to provide a directory of Canadian chemical industries and their products for the use of the trade and (2) to assemble data regarding the raw materials used, the products and by-products manufactured, imports and exports and other information calculated to indicate not only the importance of the industry, and the progress which it has made during the war, but also possible new and profitable trade openings in industrial chemical lines.

The directory includes all concerns engaged in the production of chemicals either as main products or by-products and concerns in which any of the processes used are essentially dependent on chemical change. It is divided into (1) an alphabetical list of various concerns, with the address of head offices, branch factories, and list of products; and (2) an alphabetical list of Canadian chemical products, with list of manufacturers producing each. The introduction to the directory is an able review of the recent progress and present condition of these industries.

CHESTER H. JONES.

* * *

THE METALS OF THE RARE EARTHS, a Monograph. By *James Frederick Spencer.* x + 279 pages. London and New York: Longmans, Green & Co.

One of the main causes for the slow progress realized in the industry of the rare earths was the lack of a systematic compendium of the existing but widely scattered literature on the subject. The putting on the market of Dr. J. F. Spencer's work, "The Metals of the Rare Earths," will no doubt eliminate the above-mentioned cause, and bring to the attention of those who have at heart the development of new industries the importance and adaptability of the rare metals and their salts to the constantly increasing present-day industrial and pharmaceutical demands.

This timely book covers the subject in a very logical manner from the standpoints of discovery and general progress. The profusion of the chronological and bibliographical references covering the period from the first discovery by Gadolin of a new oxide (yttria), in a mineral found at Ytterby, 1794, up to June 30, 1918, will be of the greatest help to open the field for individual research, and will also account for its becoming the *vade mecum* in the rare earths industry.

The monograph is divided into 10 chapters dealing respectively with the history of the discovery of the rare earths, their occurrence, their separation, the method of controlling their fractionation, the Cerium group (cerium, lanthanum, praseodymium, neodymium, samarium), the Yttrium group (scandium, yttrium, europium, terbium, gadolinium, erbium, dysprosium, holmium, thulium, ytterbium, lutecium, celtium), thorium, their atomic determinations, their place in Mendeleeff's periodic system, and their uses.

Not enough praise can be given to the arduous task so well fulfilled to collect and co-ordinate the 1029 references included in the book. The reference index and the indexes by authors and subjects are highly valuable adjuncts.

The assembly of the book leaves the impression that it is a useful addition to the English technical and scientific literature, and that it will find its direct use mainly in America, where the rare earths raw materials are relatively very abundant and their industry so very little developed.

J. S. NEGRU.

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QUALITATIVE CHEMICAL ANALYSIS. (A laboratory guide.) By *W. W. Scott*, Research Chemist, General Chemical Co.; 350 pp., 15 cuts; third edition. New York: D. Van Nostrand.

This very excellent text is an extension of the previous editions and follows their policy of "furnishing a practical, up-to-date guide for students studying qualitative analysis." The book is admirably adapted to this end, but where the purpose of the course is to teach largely the principles of general chemistry and to use qualitative analysis as a vehicle, this text is perhaps not so well suited.

Of this third edition the author says: "The greater portion of the text has been rewritten and new material added, although the general plan of the original work has been retained. Under 'Laboratory Exercises' a large number of chemical equations have been introduced for the purpose of emphasizing the reactions. The lists of questions at the close of each group of elements have been enlarged. In Part V, tables of chemical compounds have been added. Part VI is entirely new. This includes the less common elements, which are important on account of their technical use. This section will be of value to those desiring an extended course in qualitative analysis."

The book is unusually well printed and indexed. These facts, coupled with the careful organization, make it a book that will be especially satisfactory to the student, whether used as a laboratory manual or as a reference.

SETH C. LANGDON.

* * *

INDUSTRIAL GOODWILL. By *John R. Commons.* 214 pages, illustrated. New York: McGraw-Hill Book Co., Inc.

Professor John R. Commons of the University of Wisconsin has written a condensed treatise on problems at issue between employers and employed, in a book called Industrial Goodwill, published by the McGraw-Hill Book Co. He is modern in his views, and sane withal, which has become an attribute of distinction in the discussion of the rights and wrongs of labor and capital. He considers labor as a commodity, and again as machinery, and concludes that the descriptions are inadequate. Under Goodwill he explains how fragile and indeed how intangible it is, and yet he demonstrates that it is that which converts the "class struggle" of socialism into class harmony. Chapters on The Public, Democracy and Solidarity, develop these concepts in their relation to labor, while that entitled Theory and Practice is a little homily on common sense with "Two and Two Are Four" as his text. He declares that principles are empty until they are filled with facts, and that two dogs and two cats do not of necessity make a complete, harmonious, and perfect body of four friends. In short, it is a plea for reasonableness. There follow chapters on Security, The Labor Market, Insurance, Health and The Shop. He explains why organized labor opposes local organizations of employees that become bound in interest to single employers, and who prefer to remain in security rather than to act in concert with others who are engaged in similar occupations. Nevertheless he holds that the advantages of collective life insurance, health insurance, services of physicians and nurses, and even those features of interest which avoid turnover in employment are desirable, and do contribute to the general welfare. Under Education he says he found in Pittsburgh that the minimum value of the English language was 2 cents an hour. An employer who engages immigrants at less than the full cost of American laborers should be required to send his employees to school during the daytime, at his own expense, is an opinion expressed. "That the immigrant should become American, and that his employer should give thought and money and leadership to bring him to an understanding and love of America

is but a small compensation for what America does for them." He tells of a corporation that started a school for apprentices. "After spending considerable money on their education, as soon as the apprentices reached a point where they could return something on the investment, and even before their education was completed, other employers began to steal them away by offering higher wages." The book is anti-socialistic, but it does not indicate that all employers are beautiful white angels, by any means. Under the head of Education he also brings out the theory that interest in the day's work does not depend on a remote expectation of reaching the top; it is rather the *next step* in advance that is of interest and encouragement to the workers.

Other chapters follow on Loyalty, Personality, Depression, and The World, the last being a thoughtful review of the doctrines of Karl Marx and their influence in various countries, together with some points that Marx missed in his manifesto. He brings out how, in this country, when the war came on, the Socialists and the Industrial Workers of the World promptly took sides with Marx in his theory of internationalism, and were willing to let Germany win, while the trade unions just as promptly took the side of America. Both had similar grievances, and similar aims. But the trade unions saved us. And he believes that there are spiritual forces at work, forces of solidarity, co-operation, and of partnership which can successfully appeal to goodwill rather than to contention and hate.

The book is not a compendium for factory organization, nor will it prove of interest to the employer who wants a formula for success. But to those who think, and who are endowed with the sometimes sorrowful illumination of character, the book is worth reading and helpful as well.

ELLWOOD HENDRICK.

Personal

Mr. G. A. BURRELL, formerly chief of the Research Division, Chemical Warfare Service, is now at 120 Broadway, New York City, as vice-president of Richmond Levering & Co., Inc., president of the Island Refining Corp., vice-president and general manager of the Raritan Refining Corporation, director and member of the executive committee of the Allied Oil Corporation, and director of research of the Richmond Levering-A. B. Leach interests, the Ohio Fuel Supply Co., and the Manufacturers Light & Heat Co.

Mr. W. J. COTTON, formerly with the Color Laboratory, Bureau of Chemistry, Washington, D. C., is now with the Research Division, National Aniline & Chemical Co., Buffalo, N. Y.

Mr. R. G. HALL, manager for the Burma Mines, has been in London, and is now returning to Burma.

Dr. HAROLD HIBBERT has been appointed assistant professor of chemistry in the post-graduate research department of organic chemistry, Yale University, New Haven, Conn.

Mr. G. A. KUHL, for many years with the Bayer Co., has been appointed manager of the New York office of the United States Color & Chemical Co., 25 Howard Street.

Mr. G. H. LEE, formerly with the plant of the Tate Iron & Steel Co., Sakchi, India, and more recently with the London office of the Consolidated Steel Corporation, New York, will go to Calcutta as sales manager for the latter company.

Mr. H. W. PHILBROOK, formerly with the General Electric Co. of Schenectady, N. Y., has been appointed district manager of the Schutte & Koerting Co.'s New York office at 50 Church Street.

Mr. HOWARD R. REESE, formerly with the Standard Parts Co., Cleveland, and prior to that in the sales department of the Carnegie Steel Co., Pittsburgh, Pa., is now sales manager of the Universal Steel Co., Bridgeville, Pa., maker of alloy and tool steels.

Mr. P. A. ROELOFSEN, Commissioner of His Excellency the Governor General of the Netherlands East Indies and head of the Government's bureau for water power and electricity, together with Mr. WALTER BLASER, is studying the electrochemical industries and inspecting the hydro-electric installations of the United States and Canada.

Mr. ROSS E. WILLIS is now connected with the Lakewood Engineering Co., Cleveland, Ohio. He was formerly with the Bethlehem Steel Co. and during the war was general field assistant for the Cleveland District Ordnance Office.

Obituary

Mr. JAMES LAUGHLIN, JR., a director and a member of the executive committee of the Jones & Laughlin Steel Co., Pittsburgh, Pa., died at his home in Zellwood, Oct. 19.

Mr. ROBERT R. LUCKIE, superintendent of the Ashland Iron & Mining Co., Ashland, Ky., died Sept. 26. He was a graduate of the University of Pennsylvania and entered the steel business 15 years ago as chemist. Afterward he started in the open-hearth department and worked up to superintendent, which position he held until his death.

Mr. CHARLES N. MCFARLAND, general manager, Jaxon Steel Products Division, General Motors Corp., died at Jackson, Mich., Nov. 1, following an operation for appendicitis.

Col. H. A. MARTING, president of the Marting Iron & Steel Co., Ironton, Ohio, died Sept. 27, after a long illness.

Mr. WILLIAM A. STANTON, vice-president of the General Refractories Co., New York, died Sept. 28, in London.

Current Market Reports

The Non-Ferrous Metal Market

New York, Dec. 8, 1919:—Copper is firm, with speculators eliminated and producers in control of the market. The tin market is quiet, with light demand and ample stocks. The tone of the lead market is improving under fairly brisk demand.

	Cents per Lb.
Aluminum, 98 to 99 per cent	33.00
Antimony, wholesale lots	9.50
Nickel, ordinary	42.00
Nickel, electrolytic	45.00
Tin, Straits, spot	53.50
Lead, New York, spot	6.80
Lead, E. St. Louis, spot	6.57½
Silver (Cents per oz.)	131.00

FINISHED METAL PRODUCTS

	Warehouse Prices, Cents per Lb.
Copper sheets, hot rolled	28.50
Copper sheets, cold rolled (over 14 oz.)	30.50
Copper bottoms	37.00
Copper rods	29.50
High brass wire and sheets	25.50
High brass rods	24.50
Low brass wire and sheets	28.25
Low brass rods	28.25
Brazed brass tubing	37.25
Brazed bronze tubing	42.00
Seamless copper tubing	32.00
Seamless bronze tubing	36.00
Seamless brass tubing	30.50

SCRAP METALS

	Buying Prices
Aluminum castings	22.00–22.50
Aluminum sheets	23.00–23.50
Lead, heavy	5.50– 5.75
Lead, tea	4.62½– 4.75
Zinc, scrap	4.75– 5.00
Copper, heavy cut and crucible	16.00–16.50
Copper, heavy and wire	15.50–16.00
Copper, light and bottoms	14.00–14.50
Brass, heavy	9.50–10.00
Brass, light	8.00– 8.50

The Iron and Steel Market

The prolongation of the strike at the union bituminous coal mines has produced a high tension in the steel trade, as the majority of mills are near the end of their stock piles, and wholesale closings are likely within a fortnight if the coal mines do not resume work. The mills have received some coal since the strike started Nov. 1, particularly in the early weeks, but not a great deal, their operation being largely upon stocks. Three tin plate plants

have closed in the past week, tin mills being naturally in the vanguard in this matter, since the steel has to be heated six times in the process of manufacture.

Dec. 2 the Fuel Administration announced that production of beehive coke would be restricted 25 per cent, in order to release coal. Furnace coke had already been in urgent demand, as a scarcity was clearly in sight with coke production restricted by shortage of coal. Last June and July Connellsville furnace coke for prompt shipment sold at about $4. When the strike was three weeks old it was selling for $6, and the day before news came out of the restriction order it sold at $8, while two days after it sold at $10. The tonnages involved were very small.

With such great uncertainties prevailing as to production of steel in the next few weeks, the producers have further restricted their sales policies, but the market is not closed by any means. Business between producers and their regular customers is proceeding much as usual, since it is merely a matter of entering additional tonnages, to be shipped after present obligations are completed.

The United States Steel Corporation subsidiaries and such other steel-producing interests as adopted the policy of adhering to the March 21 schedule of prices and avoiding price advances are adhering rigidly to that policy and there is no indication that there will be any yielding in future in this matter. Expressions of opinion that the market will get out of control of the conservative interests, by tonnage demand overwhelming the mills, probably represent cases of the wish being father to the thought rather than the result of mature judgment. Many sales of steel products have been made at premium prices, but the total tonnage involved is not large, and in all cases the delivery involved is prompt or relatively early.

The Advance in Pig Iron

Further advances in pig iron have occurred in the past week, No. 2X foundry being up $1 at Philadelphia and $2 at Buffalo, while in the valley market basic is up $1 and bessemer $2 and foundry at Birmingham is up $1. Prices are now quotable as follows: Foundry iron, delivered Philadelphia, $38.10; at furnace, Buffalo, $38; Cleveland, $33; Chicago, $33; Birmingham, $34. The valley market stands at $33 for foundry and basic and $35 for bessemer, small lots having brought higher figures.

A change in the complexion of the pig iron is noted, one that may foreshadow a complete termination of the buying movement that has been sending prices upward in such excited fashion in the past few weeks. The volume of inquiry is greatly reduced and consumers in general show signs of being fairly well covered for the next few months. The point with the consumer now is not to buy iron but to be assured of delivery of what has been bought. There is little anxiety to take deliveries for the balance of this month, on account of the influence upon inventories. It is developed that considerable tonnages of iron, particularly in the East, were bought speculatively, and some of this iron is now being offered for resale. One thing the furnaces have definitely accomplished by marking up pig iron prices has been to bring about higher prices for coke, and there is a possibility that the rise in pig iron may induce an advance in Lake Superior iron ore for the 1920 season. A month ago it was regarded as definitely settled that there would be no change in ore prices.

The Chemical Market

New York, December 5, 1919.

A settled market exhibiting little activity is the record of the week, with but slight change in prices and a continued fair demand. The imminent coal shortage of a few days ago that seriously threatened some lines of the trade at the present writing is beginning to look more hopeful.

General Chemicals

The market has been sluggish due to a lack of raw materials, demand being good but the available supply not sufficient to meet the requirements. *Sodium bichromate* jumped from 15c. to 18c. per lb. and *formaldehyde* is going at 32c. per lb., against 26c. last week. Inquiries have been heavy on *sodium nitrite* at 14c. per lb. Since the Association fixed the price, *caustic soda* has remained firm at $3.80 less 5 per cent per cwt. f.a.s. N. Y. *Sulphuric acid, 60 deg.* is quoted at $23 per ton.

Coal-Tar Products

General conditions point to another increase in prices throughout the list and this observation has been strengthened by a rumor going around the trade that the jump will come soon. Inquiries have been numerous on *alpha naphthylamine* at 35c. per lb., with very little to be had, while *paranitrotoluol*, at $1.50 per lb., is practically off the market. *Aniline salts* is still rising, being quoted at 40c. per lb., with a jump in *dimethylaniline* to 67c., against the last quotation of 65c., while *salicylic acid* is 55c. per lb., against 48c. in the previous report.

Waxes

Inquiries have been heavy in this market, with a slight scarcity of material the only hindrance to an otherwise very active market. *Beeswax, refined yellow*, is to be had at 44-47c. per lb., and *white pure* has fallen to 63-65c. *Candelilla* has been cut to 33c. per lb., and *carnauba, No.* 2 *North Country*, dropped to 46c. per lb., and *No.* 3 *North Country* to 46c. per lb., while *Japan* jumped to 21c. per lb.

Flotation oils have been dull, with pine oil, steam distilled, advanced to $1.25 per gal., and crude turpentine to $1.20 per bal., while hardwood oil, 0.960-0.990, f.o.b. Mich., is now selling at 35c. per gal.

Vegetable oils have been quiet; linseed oil raw is quoted at $1.87 per gal., boiled $1.89, and rapeseed oil (blown) jumped from $1.70 to $1.75 per gal., while peanut oil crude, f.o.b. South, is 2c. higher than last week, the present price being 23½c. lb. Exporting has been rather heavy in *naval stores*, with Japan a heavy buyer, especially in the medium grades. Rosin is quoted at $17-$17.65 per bbl. (280 lb.), while spirits of turpentine range from $1.61-$1.65 per gal.

The effects of the coal situation have probably been felt most acutely in the *crude rubber* trade, several tire plants having reduced output. The market is at a standstill with very little material available in any of the grades. A nominal quotation of 51¾-53c. per lb. is given on crepe, and ribbed smoked is priced at 51¾c., while fine para is going at 48½c.

Ferro-alloy prices in general remain unchanged, with continued brisk demand and a slight lagging of supply in some quarters. Inquiries, both foreign and domestic, are still heavy, with several establishments contracting into the new year.

The steady advance in the production of steel has caused a very heavy demand on ferromanganese, quoted at $115 gross ton, with manganese ore receiving considerable attention. The arrival of 1000 tons of chrome ore from South Africa has not materially affected the market of this item, still quoted at 30c. per lb., chrome contained, while the use of molybdenite in place of vanadium in the manufacture of alloy steel has not changed the general condition, the old price of 75c. per lb. MoS_2 remaining. Exporting in wolframite has been dull, as Europe can get it by direct shipment from China, due to rate of exchange, at a price below our present quotation of $7-$8 per unit.

Feldspar remains lethargic. There is no material on hand and inquiries continue to pour in, while *barytes* remains firm at $34-$36 per ton with a sharp domestic demand. The uncertainty as to whether the Government will decide that petroleum coke is a fuel and fix the price with the attendant preference list, or allow the producer to continue making his own price has clouded matters in this field. The return of the miners to their work would undoubtedly settle this question.

The continued rise in *shellacs* is caused by a shortage of Calcutta crops, but with the advent of a new crop at hand it is hoped that the stringency will be relieved. TN has jumped to $1.20 per lb., while orange fine and superfine continue to rise, the former quoted at $1.35 per lb. and the latter at $1.25. A.C. garnet and bleached, bone dry and fresh ground, have each increased 5c. a lb. The return of the Calcutta exchange to normal will entail a general rise.

General Chemicals

WHOLESALE PRICES IN NEW YORK MARKET, NOV. 30, 1919

		Carlots	Less Carlots
Acetic anhydride	lb.	.....	$0.60 -$0.65
Acetone	lb.	$0.13½-$0.15	.15 - .15½
Acid, acetic, 28 per cent.	cwt.	2.50 - 2.75	3.00 - 3.25
Acetic, 56 per cent.	cwt.	5.00 - 5.50	6.00 - 6.50
Acetic, glacial, 99½ per cent, carboys	cwt.	12.00 -12.60	12.90 -13.50
Boric, crystals	lb.	13½-	..... .14½
Boric, powder	lb.	.12 - .13½	.13½- .14
Hydrochloric, (muriatic) tech. 20 deg.	cwt.	1.50 - 1.75	2.00 - 2.50
Hydrofluoric, 52 deg.	lb.	.12 -	.14 - .....
Lactic, 44 per cent. tech	lb.	.11 - .14	.12 - .16
Lactic, 22 per cent. tech	lb.	.05 - .06	.05½- .07
Molybdic, C. P.	lb.	..... -	4.00 - 4.25
Nitric, 40 deg.	lb.	.08 -	.07 - .08½
Nitric, 42 deg.	lb.	.07 - .07½	.08 - .....
Oxalic, crystals	lb.	.23 - .24½	.25 - .33
Phosphoric, Ortho, 50 per cent. solution	lb.	.11 -	.12 - .14
Picric	lb.	.30 - .35	.40 - .50
Pyrogallic, resublimed	lb.	..... -	2.30 - 2.60
Sulphuric, 60 deg., tank cars	ton	..... -	..... - .....
Sulphuric, 60 deg., drums	ton	17.00 -	22.00 - .....
Sulphuric, 60 deg., carboys	ton	20.00 -	25.00 - .....
Sulphuric, 66 deg., tank cars	ton	17.00 -18.00	22.00 -23.00
Sulphuric, 66 deg., drums	ton	20.00 -21.00	25.00 -26.00
Sulphuric, 66 deg., carboys	ton	25.00 -	30.00 -40.00
Sulphuric, fuming, 20 per cent. (oleum) tank cars	ton	25.00 -	26.00 - .....
Sulphuric, fuming, 20 per cent. (oleum) drums	ton	30.00 -	33.00 - .....
Sulphuric, fuming, 20 per cent. (oleum) carboys	ton	30.00 -	35.00 - .....
Tannic, U. S. P.	lb.	..... -	1.35 - 1.45
Tannic (tech.)	lb.	..... -	.42 - .70
Tartaric, crystals	lb.	..... -	.72 - .75
Tungstic, per lb. of WO	lb.	..... -	1.20 - 1.40
Alcohol, Ethyl	gal.	5.00 -	5.50 - .....
Alcohol, Methyl	gal.	1.40 -	1.43 - .....
Alcohol, denatured, 188 proof	gal.	.58 - .60	.60 - .64
Alcohol, denatured, 190 proof	gal.	.54 - .56	56 - .60
Alum, ammonia lump	lb.	..... - .04½	..... - .04½
Alum, potash lump	lb.	.07½- .08½	.08 - .10½
Alum, chrome lump	lb.	.15 - .16	.18 - .20
Aluminum sulphate, commercial	lb.	..... - .02	.02½- .02½
Aluminum sulphate, iron free	lb.	.02½- .03	.03½- .03½
Aqua ammonia, 26 deg., drums (750 lb.)	lb.	.09 -	.10 - .....
Ammonia, anhydrous, cylinders (100-150 lb.)	lb.	..... -	.30 - .35
Ammonium carbonate, powder	lb.	.13 - .13½	.14 - .15
Ammonium chloride, granular (white salammoniac)	lb.	.12½- .13	.13½- .14
Ammonium chloride, granular (gray salammoniac)	lb.	.12 - .12½	.13 - .13½
Ammonium nitrate	lb.	.10 -	.11 - .12
Ammonium sulphate	lb.	.06½-	.06½- .....
Amyl acetate	gal.	..... -	3.65 - 3.75
Arsenic, oxide, lumps (white arsenic)	lb.	..... -	.10½- .11
Arsenic, sulphide, powdered (red arsenic)	lb.	..... -	.23 - .24
Barium chloride	ton	75.00 -	85.00 -100.00
Barium dioxide (peroxide)	lb.	.22 -	.24 - .....
Barium nitrate	lb.	.10 - .10½	.11 - .12
Barium sulphate (precip.) (blanc fixe)	lb.	.03 - .03½	.03½- .04
Bleaching powder (see calcium hypochlorite)		..... -	..... - .....
Blue Vitriol (see copper sulphate)		..... -	..... - .....
Borax (see sodium borate)		..... -	..... - .....
Brimstone (see sulphur, roll)		..... -	..... - .....
Bromine	lb.	..... -	.65 - .75
Calcium acetate	cwt.	2.00 - 2.05	2.10 - .....
Calcium carbide	lb.	..... -	.04½- .05
Calcium chloride, fused, lump	ton	19.00 -25.00	30.00 -40.00
Calcium chloride, granulated	lb.	.01½- .01½	.02 - .02½
Calcium hypochlorite (bleaching powder)	cwt.	2.25 - 2.50	- 2.75
Calcium peroxide	lb.	..... -	1.50 - 1.70
Calcium phosphate, monobasic	lb.	..... -	.75 - .....
Calcium sulphate, precipitated	lb.	..... -	.09 - .09½
Carbon bisulphide	lb.	.06 -	.06½- .....
Carbon tetrachloride, drums	lb.	.10 - .11	.12 - .14
Carbonyl chloride (phosgene)	lb.	..... -	.75 - .....
Caustic potash (see potassium hydroxide)		..... -	..... - .....
Caustic soda (see sodium hydroxide)		..... -	..... - .....
Chlorine, gas, liquid-cylinders (100 lb.)	lb.	.05 - .05½	.08 - .....
Cobalt oxide	lb.	..... -	1.50 - 1.55
Copperas (see iron sulphate)		..... -	..... - .....
Copper carbonate, green precipitate	lb.	..... -	.28 - .31
Copper cyanide	lb.	..... -	.65 - .70
Copper sulphate, crystals	lb.	.08½- .08¾	.09 - .09½
Cream of tartar (see potassium bitartrate)		..... -	..... - .....
Epsom salt (see magnesium sulphate)		..... -	..... - .....
Formaldehyde, 40 per cent.	lb.	..... -	.30- .35
Glauber's salt (see sodium sulphate)		..... -	..... - .....
Glycerine	lb.	..... -	.24½- .26
Iodine, resublimed	lb.	..... -	4.50 - .....
Iron oxide, red	lb.	..... -	.03 - .20
Iron sulphate, (copperas)	cwt.	1.25 -	1.35 - 1.50
Lead acetate, normal	lb.	..... -	.15 - .16
Lead arsenate (paste)	lb.	..... -	.13 - .17
Lead nitrate, crystals	lb.	..... -	.85 - .86½
Litharge	lb.	..... -	.09½- .10½
Lithium Carbonate	lb.	..... -	.50 - .....
Magnesium carbonate, technical	lb.	..... -	.13 - .14½
Magnesium sulphate, U. S. P.	100 lb.	2.00 - 2.63	2.75 - 3.00
Magnesium sulphate, commercial	100 lb.	1.75 -	2.00 - 2.50
Nickel salt, double	lb.	.14 -	.15 - .....
Nickel salt, single	lb.	.12 -	.15 - .16
Phosgene (see carbonyl chloride)		..... -	..... - .....
Phosphorus, red	lb.	..... -	.60 - .70
Phosphorus, yellow	lb.	..... -	.35 - .37
Potassium bichromate	lb.	.28 -	.30 - .....
Potassium bitartrate (cream of Tartar)	lb.	..... -	.58 - .60
Potassium bromide, granular	lb.	..... -	.74 - .....
Potassium carbonate, U. S. P.	lb.	.55 -	.60 - .65
Potassium carbonate, crude	lb.	.25 -	.27 - .....
Potassium chlorate, crystals	lb.	.18 - .20	.21 - .....
Potassium cyanide, 98-99 per cent.	lb.	nominal	
Potassium hydroxide (caustic potash)	lb.	.32 - .35	.36 - .42
Potassium iodide	lb.	..... -	3.55 - 3.60
Potassium nitrate	lb.	.19 -	.21 - .....
Potassium permanganate	lb.	..... -	.55 - .65
Potassium prussiate, red	lb.	..... -	1.05 - 1.15
Potassium prussiate, yellow	lb.	..... -	.36 - .60
Potassium sulphate	ton	225.00 -	..... - .....
Rochelle salts (see sodium potas, tartrate)		..... -	..... - .....
Salammoniac (see ammonium chloride)		..... -	..... - .....
Sal soda (see sodium carbonate)		..... -	..... - .....
Salt cake (sodium sulphate)	ton	17.00 -21.00	..... - .....
Silver cyanide	oz.	..... -	1.19 - .....
Silver nitrate	oz.	..... -	.80½- .81½
Soda ash, light	100 lb.	1.90 - 2.05	2.10 - .....
Soda ash, dense	100 lb.	2.15 - 2.25	2.30 - 2.50
Sodium acetate	lb.	.06½- .07	.07½- .08
Sodium bicarbonate	100 lb.	2.35 -	2.75 - 3.00
Sodium bichromate	lb.	.15½- .16	.17 - .18
Sodium bisulphate (nitre cake)	ton	3.00 - 8.00	10.00 - .....
Sodium bisulphite	cwt.	1.80 - 1.90	2.00 - 2.10
Sodium borate (borax)	lb.	.09 -	.10 - .....
Sodium carbonate (sal soda)	100 lb.	1.35 - 1.50	1.50 - 1.75
Sodium chlorate	lb.	.12 -	.13 - .14
Sodium cyanide, 96-98 per cent.	lb.	.30 -	.31 - .34
Sodium fluoride	lb.	.14 -	.16 - .17
Sodium hydroxide (caustic soda)	100 lb.	3.40 - 3.60	3.65 - 3.70
Sodium molybdate	lb.	2.50 -	3.25 - .....
Sodium nitrate	100 lb.	..... - 3.25	3.75 - 4.00
Sodium nitrite	lb.	..... - .15	..... - .16
Sodium peroxide, powdered	lb.	..... -	.30 - .32
Sodium phosphate, dibasic	lb.	.03½- .04	.04½- .05
Sodium potassium tartrate (Rochelle salts)	lb.	..... -	.41 - .44
Sodium prussiate, yellow	lb.	.23 - .25	.26 - .27
Sodium silicate, solution (40 deg.)	lb.	.01½- .02	.02 - .02½
Sodium silicate, solution (60 deg.)	lb.	.02½- .03	.03½- .04½
Sodium sulphate, crystals (Glauber's salts)	cwt.	1.15 - 1.25	1.50 - 2.00
Sodium sulphide, crystal, 60-62 per cent. (conc)	lb.	..... -	.05 - .06
Sodium sulphite, crystals	lb.	.03½-	.04 - .06
Strontium nitrate, crystals	lb.	.25 -	.28 - .....
Sulphur chloride	lb.	.05½-	.06 - .....
Sulphur, crude	ton	22.00 -	..... - .....
Sulphur dioxide, liquid, cylinders	lb.	..... -	.10 - .12
Sulphur (sublimed), flour	100 lb.	3.10 -	3.40 - 3.65
Sulphur, roll (brimstone)	100 lb.	2.95 -	3.15 - 3.40
Tin bichloride (stannous)	lb.	.44 -	.46 - .50
Tin oxide	lb.	..... -	.60 - .....
Zinc carbonate, precipitate	lb.	..... -	.20 - .....
Zinc chloride, gran.	lb.	.12½-	.13½- .14
Zinc cyanide	lb.	.49 -	.50 - .....
Zinc dust	lb.	.09 - .11	.11 - .14
Zinc oxide, dry American	lb.	..... -	.09½- .09½
Zinc sulphate	lb.	.03½- .03½	.04 - .04½

Coal-Tar Products

NOTE—The following prices are for original packages in large quantities:

Alpha naphthol, crude	lb.	$1.00 —	$1.10
Alpha naphthol, refined	lb.	1.40 —	1.50
Alpha naphthylamine	lb.	.35 —	.50
Aniline oil, drums extra	lb.	.34 —	.38
Aniline salts	lb.	.36 —	.42
Anthracine, 80% in drums (100 lb.)	lb.	.90 —	1.00
Benzaldehyde (f.f.c.)	lb.	1.00 —	1.15
Benzidine, base	lb.	1.10 —	1.25
Benzidine, sulphate	lb.	.95 —	1.15
Benzoic acid, U. S. P.	lb.	.90 —	1.10
Benzoate of soda, U. S. P.	lb.	.80 —	1.00
Benzol, pure, water-white, in drums (100 lb.)	gal.	.36 —	.....
Benzol, 90%, in drums (100 lb.)	gal.	.24 —	.28
Benzyl chloride, 95-97%, refined	lb.	.35 —	.40
Benzyl chloride, tech	lb.	.25 —	.35
Beta naphthol benzoate	lb.	3.75 —	4.50
Beta naphthol, sublimed	lb.	.75 —	.80
Beta naphthol, tech.	lb.	.50 —	.55
Beta naphthylamine, sublimed	lb.	2.25 —	2.35
Cresol, U. S. P., in drums (100 lb.)	lb.	.18 —	.....
Ortho-cresol, in drums (100 lb.)	lb.	.23 —	.25
Cresylic acid, 97-99%, straw color, in drums	gal.	.80 —	.85
Cresylic acid, 95-97%, dark, in drums	gal.	.85 —	.90
Cresylic acid, 50%, first quality, drums	gal.	.60 —	.....
Dichlorbenzol	lb.	.07 —	.10
Diethylaniline	lb.	1.40 —	2.25
Dimethylaniline	lb.	.57 —	.67
Dinitrobenzol	lb.	.27 —	.37
Dinitrochlorbenzol	lb.	.25 —	.30
Dinitronaphthaline	lb.	.45 —	.55
Dinitrophenol	lb.	.27 —	.36
Dinitrotoluol	lb.	.38 —	.45
Dip oil, 25%, tar acids, car lots, in drums	gal.	.38 —	.65
Diphenylamine	lb.	.58 —	.75
H-acid	lb.	1.55 —	1.70
Metaphenylenediamine	lb.	1.10 —	1.25
Monochlorbenzol	lb.	.12 —	.15
Monoethylaniline	lb.	1.50 —	1.75
Naphthaline crushed, in bbls. (250 lb.)	lb.	.06 —	.08
Naphthaline, flake	lb.	.06½ —	.07½
Naphthaline, balls	lb.	.08½ —	.10
Naphthionic acid, crude	lb.	.75 —	1.25
Nitrobenzol	lb.	.14 —	.19
Nitro-naphthaline	lb.	.35 —	.45
Nitro-toluol	lb.	.40 —	.50
Ortho-amidophenol	lb.	3.75 —	4.25
Ortho-dichlor-benzol	lb.	.15 —	.20
Ortho-nitro-phenol	lb.	.90 —	1.25
Ortho-nitro-toluol	lb.	.25 —	.40
Ortho-toluidine	lb.	.25 —	.32
Para-amidophenol, base	lb.	2.75 —	3.50
Para-amidophenol, HCl	lb.	2.75 —	3.25
Para-dichlor-benzol	lb.	.15 —	.18
Paranitraniline	lb.	1.10 —	1.20
Para-nitro-toluol	lb.	1.35 —	1.50
Paraphenylenediamine	lb.	2.50 —	3.00
Paratoluidine	lb.	2.00 —	2.25
Phthalic anhydride	lb.	1.00 —	1.50
Phenol, U. S. P., drums (dest.), (240 lb.)	lb.	.18 —	.....
Pyridin	gal.	2.50 —	.....
Resorcin, technical	lb.	3.50 —	3.75
Resorcin, pure	lb.	6.50 —	6.75
Salicylic acid, tech., in bbls. (110 lb.)	lb.	.50 —	.55
Salicylic acid, U. S. P.	lb.	.55 —	.60
Salol	lb.	.90 —	.95
Solvent naphtha, water-white, in drums, 100 gal.	gal.	.20 —	.27
Solvent naphtha, crude, heavy, in drums, 100 gal.	gal.	.18 —	.42
Sulphanilic acid, crude	lb.	.26 —	.30

Tolidine	lb.	$1.70 —	$2.50
Toluidine, mixed	lb.	.45 —	.55
Toluol, in tank cars	gal.	.27 —	.....
Toluol, in drums	gal.	.28 —	.30
Xylidine, drums, 100 gal.	lb.	.44 —	.50
Xylol, pure, in drums	gal.	.37 —	.45
Xylol, pure, in tank cars	gal.	.35 —	.....
Xylol, commercial, in drums, 100 gal.	gal.	.23 —	.27
Xylol, commercial, in tank cars	gal.	.22 —	.....

Waxes

Prices based on original packages in large quantities.

Beeswax, natural crude, yellow	lb.	$0.41 —	$0.43
Beeswax, refined, yellow	lb.	.46 —	.48
Beeswax, white pure	lb.	.63 —	.65
Carnauba, No. 1	lb.	.84 —	.86
Carnauba, No. 2, regular	lb.	.75 —	.78
Carnauba, No. 3, North Country	lb.	.46 —	.47
Japan	lb.	.20 —	.21
Paraffine waxes, crude match wax (white) 105-110 m.p.	lb.	.06 —	...
Paraffine waxes, crude, scale 124-126 m.p.	lb.	.06½ —	.07
Paraffine waxes, refined, 118-120 m.p.	lb.	.08½ —	.09
Paraffine waxes, refined, 128-130 m.p.	lb	.09½ —	.09½
Paraffine waxes, refined, 133-135 m.p.	lb.	.11 —	.11½
Paraffine waxes, refined, 135-137 m.p.	lb.	.12 —	.13½
Stearic acid, single pressed	lb.	.23 —	.26
Stearic acid, double pressed	lb.	.28 —	.29
Stearic acid, triple pressed	lb.	.32 —	.33

NOTE—Quotations on paraffine waxes are nominal.

Flotation Oils

All prices are f.o.b. New York, unless otherwise stated, and are based on carload lots. The oils in 50-gal. bbls., gross weight, 500 lb.

Pine oil, steam dist., sp. gr., 0.930-0.940	gal.	$1.25
Pine oil, pure, dest. dist.	gal.	1.05
Pine tar oil, ref., sp. gr. 1.025-1.035	gal.	.80
Pine tar oil, crude, sp.gr. 1.025-1.035 tank cars f.o.b. Jacksonville, Fla.	gal.	.47
Pine tar oil, double ref., sp.gr. 0.965-0.990	gal.	.65
Pine tar, ref., thin, sp. gr., 1.080-1.960	gal.	.38
Turpentine, crude, sp. gr., 0.900-0.970	gal.	1.20
Hardwood oil, f.o.b. Mich., sp. gr., 0.960-0.990	gal.	.35
Pinewood creosote, ref.	gal.	.51

Naval Stores

The following prices are f.o.b., New York, for carload lots.

Rosin B-D, bbl.	280 lb.	$17.65 —	$18.25
Rosin E-I	280 lb.	17.75 —	19.50
Rosin K-N	280 lb.	20.00 —	22.25
Rosin W. G.-W. W.	280 lb.	22.50 —	24.00
Wood rosin, bbl.	280 lb.	17.00 —	17.50
Spirits of turpentine	gal.	1.65 —	....
Wood turpentine, steam dist.	gal.	1.61 —	....
Wood turpentine, dest. dist.	gal.	1.50 —	....
Pine tar pitch, bbl.	200 lb.	8.25 —	8.50
Tar, kiln burned, bbl. (500 lb.)	bbl.	14.50 —	14.75
Retort tar, bbl.	280 lb.	15.00 —	15.50
Rosin oil, first run	gal.	.86 —	.91
Rosin oil, second run	gal.	.88 —	.93
Rosin oil, third run	gal.	.95 —	1.12
Rosin oil, fourth run	gal.	1.05 —	1.15

Solvents

73-76 deg., steel bbls. (85 lb.)	gal.	$0.33½
70-72 deg., steel bbls. (85 lb.)	gal.	.31½
68-70 deg., steel bbls. (85 lb.)	gal.	.30½
V. M. and P. naphtha, steel bbls. (85 lb.)	gal.	.23½

Crude Rubber

Para—Upriver fine	lb.	$0.49½ —	$0.49½
Upriver coarse	lb.	.34½ —	.35½
Upriver caucho ball	lb.	.34½ —	.35½
Plantation—First latex crepe	lb.	.52 —	.53½
Ribbed smoked sheets	lb.	.51½ —	.52½
Brown crepe, thin, clean	lb.	.46½ —	.47½
Amber crepe No. 1	lb.	.50 —	.51

Oils

VEGETABLE

Unless otherwise noted, the following prices are f.o.b., New York.

Castor oil, No. 3, in bbls.	lb.	$0.18½ —	$0.19
Castor oil, AA, in bbls.	lb.	.21½ —	.22
China wood oil, in bbls.	lb.	.22½ —	.23
Cocoanut oil, Ceylon grade, in bbls.	lb.	.17½ —	.18½
Cocoanut oil, Cochin grade, in bbls.	lb.	.19½ —	.20
Corn oil, crude, in bbls.	lb.	.... —	.21½
Cottonseed oil, crude (f.o.b. mill)	lb.	.... —	.19
Cottonseed oil, summer yellow	lb.	.23½ —	.24
Cottonseed oil, winter yellow	lb.	.24½ —	.25
Linseed oil, raw, car lots	gal.	1.80 —	1.87
Linseed oil, raw, tank cars	gal.	1.72 —	....
Linseed oil, boiled, car lots	gal.	1.82 —	....
Olive oil, commercial	gal.	2.50 —	2.80
Palm, Lagos	lb.	.17 —	.17½
Palm, bright red	lb.	.16½ —	.17½
Palm, Niger	lb.	.16 —	.18
Peanut oil, crude, tank cars (f.o.b. mill)	lb.	.23½ —	.23½
Peanut oil, refined, in bbls.	lb.	.27 —	.28
Rapeseed oil, refined in bbls.	gal.	1.45 —	1.50
Rapeseed oil, blown, in bbls.	gal.	1.60 —	....
Soya bean oil (Manchurian), in bbls., N. Y.	lb.	.17½ —	.18½
Soya bean oil, tank cars, f.o.b., Pacific coast	lb.	.15½ —	.15½

FISH

Winter pressed Menhaden	gal.	$1.20 —	.....
Yellow bleached Menhaden	gal.	1.23 —	....
White bleached Menhaden	gal.	1.25 —	.....
Blown Menhaden	gal.	1.30 —	....

Miscellaneous Materials

All Prices f.o.b., N. Y.

Barytes, domestic, white, floated	ton	$35.00 —	$40.00
Barytes, off color	ton	20.00 —	25.00
Blanc fixe, dry	lb.	.03½ —	.04½
Blanc fixe, pulp	ton	47.50 —	50.00
Casein	lb	.16 —	.18
Chalk, English, extra light	lb.	.05 —	.07
Chalk, English, light	lb	.04½ —	.05
Chalk, English, dense	lb.	$ .04 —	$ .05
China clay (Kaolin), imported, lump	ton	25.00 —	35.00
China clay (Kaolin), imported, powdered	ton	30.00 —	60.00
China clay (Kaolin), domestic, lump	ton	10.00 —	20.00
China clay (Kaolin), domestic, powdered	ton	25.00 —	40.00
Feldspar	ton	13.50 —	17.00
Fluorspar, acid grade, lump, f.o.b. mines	net ton	30.00 —	35.00
Fluorspar, acid grade, ground, f.o.b. mines	net ton	35.00 —	45.00
Fuller's earth, domestic, powdered	ton	25.00 —	30.00
Fuller's earth, imported, powdered	ton	35.00 —	40.00
Pumice stone, imported	lb.	.03 —	.06
Pumice stone, domestic	lb.	.02½ —	.....
Shellac, TN	lb.	1.10 —	1.15
Shellac, D. C.	lb.	..... —	....
Shellac, V. S. O.	lb.	..... —	....
Shellac, Diamond I.	lb.	..... —	....
Shellac, orange, fine	lb.	1.25 —	.....
Sheilac, orange, superfine	lb.	1.20 —	1.30
Shellac, A.C. garnet	lb.	1.10 —	.....
Shellac, bleached, bone dry	lb.	1.35 —	.....
Shellac, bleached, fresh ground	lb.	1.10 —	1.15
Soapstone	ton	15.00 —	25.00
Talc, domestic	ton	16.00 —	60.00
Talc, imported	ton	60.00 —	70.00

Refractories

Following prices are f.o.b. works:

Chrome brick	net ton	80-90 at Chester, Penn.
Chrome cement	net ton	45-50 at Chester, Penn.
Clay brick, 1st quality fireclay	1,000	35-45 at Clearfield, Penn.
Clay brick, 2nd quality	1,000	30-35 at Clearfield, Penn.
Magnesite, dead burned	net ton	50-55 at Chester, Penn.
Magnesite brick, 9 x 4½ x 2½ in.	net ton	80-90 at Chester, Penn.
Silica brick	1,000	41-45 at Mt. Union, Penn.

Ferro-alloys

All prices f.o.b. works.

Ferro-carbon-titanium, 15-18%, f.o.b. Niagara Falls, N. Y.	net ton	$200.00	—$250.00
Ferro-chrome, per lb. of Cr. contained, 6-8% carbon	lb.	.25	—	.40
Ferro-chrome, per lb. of Cr. contained, 2-4% carbon	lb.	.70	—	.....
Ferro-manganese, 70-80% Mn	gross ton	110.00	—	115.00
Spiegeleisen, 16-20% Mn	gross ton	33.00	—	36.00
Ferro-molydenum, per lb. of Mo	lb.	3.00	—	3.50
Ferro-silicon, 50%	gross ton	85.00	—	95.00
Ferro-silicon, 75%	gross ton	150.00	—	175.00
Ferro-silicon, 10-15%	gross ton	45.00	—	60.00
Ferro-tungsten, 70-80%, per lb. of contained W.	lb.	1.25	—	1.40
Ferro-uranium, 35-50%, of U	lb.	7.00	—	.....
Ferro-vanadium, 30-40% per lb. of contained V.	lb.	5.50	—	7.00

Ores and Semi-finished Products

Chrome ore, 35-40%, Cr_2O_3	unit	$0.60 —	$0.80
Chrome ore, 48% and over	unit	1.00 —	1.25
Coke, foundry, f.o.b. ovens	net ton	7.00 —	7.50
Coke, furnace, f.o.b. ovens	net ton	6.00 —	6.50
Petroleum coke, refinery, Atlantic seaboard	net ton	12.00 —	12.50
Fluorspar, gravel, f.o.b. mines	net ton	..... —	25.00
Manganese ore, 45% Mn and over	unit	.50 —	.75
Manganese ore, chemical (MnO_2)	gross ton	60.00 —	70.00
Molybdenite, 85% MoS_2, per lb. of MoS_2	lb.	.75 —	.85
Tungsten, Scheelite, 60% WO_3 and over, per unit of WO_3	unit	9.00 —	15.00
Tungsten, Wolframite, 60% WO_3 and over, per unit of WO_3	unit	7.50 —	10.00
Uranium oxide, 96%	lb.	2.75 —	3.00
Vanadium pentoxide, 99%	lb.	6.00 —	.....
Pyrites, foreign, lump	unit	.17 —	.....
Pyrites, foreign, fine	unit	.17 —	.....
Pyrites, domestic, fine	unit	.16 —	.17½
Ilmenite, 52% TiO_2	lb.	.02 —	.....
Rutile, 95% TiO_2	lb.	.11 —	.....
Carnotite, minimum 2% U_3O_8, per lb. of U_3O_8	lb.	2.75 —	3.00
Zircon, washed, iron free	lb.	.10 —	.....
Monazite, per unit of ThO_2	unit	42.00 —	.....

Plant Materials and Supplies

In carload lots, New York, unless otherwise stated.

BUILDING MATERIALS

Portland cement, at dock, without bags	bbl.	$2.80
Lump lime, common, including container	300 bbl.	2.65
Common brick, at dock	M.	16.00
Yellow pine, 3x4 to 8x8, 20 ft. and under	M.	48.00
Yellow pine, 3x4 to 8x8, 20 ft. and under at Chicago	M.	50.00
Yellow pine, 3x4 to 8x8, 20 ft. and under at St. Louis	M.	40.00
Roofings, tar felt (14 lb. per 100 sq.ft.)	ton	70.00
Roofings, tar pitch (in 400-lb. bbl.) carlots	ton	21.00
Roofings, asphalt pitch carlots	ton	34.00
Roofings, asphalt felt carlots	ton	63.00
Roofings, slate-surfaced, per roll of 108 sq.ft. carlots		2.25
Roofings, slate-finished shingles, 100 sq.ft. carlots		6.00
Linseed oil, raw in barrels	gal.	1.75
Linseed oil, 5 gal. cans	gal.	1.90
Red lead, dry, 100 lb. keg	lb.	.13
Red lead, in oil, 100 lb. keg	lb.	.14½
Red lead, dry, 5 lb. cans	lb.	.15
Red lead, in oil, 5 lb. cans	lb.	.16½
White lead, dry and in oil, 100 lb. keg	lb.	.13
White lead, dry and in oil, 25 and 50 lb. kegs	lb.	.13½
White lead, dry and in oil, 5 lb. cans	lb.	.15

STRUCTURAL STEEL, MILL, PITTSBURGH

Beams and channels, 3 to 15-in.	100 lb.	$2.45
Angles, 3 to 6-in., ¼-in. thick	100 lb.	2.45
Tees, 3-in. and larger	100 lb.	2.45
Plates	100 lb.	2.66
Rivets, structural, ½-in. and larger	100 lb.	4.20
Rivets, conehead for boilers, ½-in. and larger	100 lb.	4.30
Sheets, No. 28 black	100 lb.	4.35
Sheets, No. 10 blue annealed	100 lb.	3.55
Sheets, No. 28 galvanized	100 lb.	5.70

For painted corrugated sheets, add 30c. per 100 lb. for 25 to 28 gage; 25c. for 19 to 24 gage; for galvanized corrugated sheets, add 15c., all gages.

INDUSTRIAL

Financial, Construction and Manufacturers' News

Construction and Operation

NOTE—These items were compiled as of Dec. 5, but appear in this issue due to the delay in publication due to the printers' strike.

District of Columbia

WASHINGTON—The Bureau of Standards will soon award the contract for furnishing material and constructing 8 chemical laboratory tables complete with superstructure, drain boards, and peg racks, and 2 of same without superstructure, drain boards and peg racks, and 10 maple top tables, 7 ft. long, 30 in. wide, and 1¼ in. thick.

Florida

MURDOCK—W. S. Wilson, Dothan, Ala., has purchased a large acreage of timber land near here, and plans to construct a turpentine distillery on same.

Iowa

WINFIELD—The city will receive bids early in January for the construction of sewers and a sewage disposal plant. Estimated cost, $100,000. H. R. Green, 101 West 2nd St., Cedar Rapids, engineer.

Maryland

CURTIS BAY (Baltimore P.O.)—The Standard Wholesale Phosphate Co., 1214 Continental Bldg., has awarded the contract for the construction of a 1-story 60 x 216 x 320-ft. acid phosphate plant on Aspin St., to the Whiting-Turner Construction Co., Stewart Bldg., Baltimore. Estimated cost, $72,000.

Michigan

DETROIT—The General Carbon Co., 542 5th Ave., New York City, has awarded the contract for the construction of a 1-story, 100 x 120 ft. manufacturing plant, a 1-story, 40 x 50 ft. boiler house and a 1-story, 25 x 30-ft. garage, to the Austin Co., 217 Broadway, New York City. Estimated cost, $75,000.

North Dakota

WILLISTON—The city plans to install a new filter bed and make alterations in present waterworks plant. Miss Jack, city engineer.

Ohio

CLEVELAND—A. A. Chilcote Co. has purchased a site on East 21st St. and Superior Ave., and plans to construct a 2-story photographers commercial building on same. Estimated cost, $100,000. A. A. Chilcote, 733 Prospect Ave., president.

CLEVELAND—The Middle States Rubber Co., recently incorporated, plans to construct a large factory for the manufacture of tires, tubes and other rubber articles, in this vicinity. James L. Lind, Municipal Court, and E. Ewing, 3206 West 98th St., interested.

HIRAM—Hiram College plans a campaign to obtain funds to construct a 4-story men's dormitory and science building. Estimated cost, $600,000. F. A. Henry, 405 Sloan Bldg., Cleveland, manager in charge. Abram Garfield, National City Bank Bldg., Cleveland, engineer.

Oklahoma

OKLAHOMA CITY—The State Board of Health has ordered the city to install a sewage disposal plant. Estimated cost, $1,000,000.

New Jersey

JERSEY CITY—The city will soon award the contract for the furnishing and delivering of hypochlorite of lime and liquid chlorine for a period of 12 months for the treatment of Jersey City water supply at Boonton.

Texas

PLAINVIEW—The City Council will soon award the contract for the construction of a sewage treatment plant, consisting of Imhoff tank and sprinkling filters, filter material, etc., J. F. Frye, secretary.

Washington

SEATTLE—F. A. Narramore, architect, Central Bldg., will soon receive bids for the construction of a 3-story, 250 x 250-ft. factory on 8th and Dexter Sts., for the manufacture of school furniture, laboratory equipment, etc. for the School Board. Estimated cost, $160,000.

Wisconsin

MADISON—The Madison Kipp Lubricating Co., Waubesa St., has awarded the contract for the construction of a 52 x 240-ft. addition to its present shop, to George C. Cnare & Son, 2000 Jenifer St. Estimated cost, $200,000.

British Columbia

SQUAMISH—R. Hudson, Everett, Wash., is conducting preliminary negotiations with a view to constructing a pulp mill at the terminus of the Pacific Great Eastern Railway, near here, for the American Syndicate. Estimated cost, $1,000,000. John Callaghan, Vancouver, engineer.

Ontario

BOSTON CREEK—The Miller Independent Mines, Ltd., plans to construct a 100-ton mill, also install a new electrical plant, in connection with its gold mine here. C. A. Miller, superintendent.

PORT CREDIT—The St. Laurence Starch Co. has awarded the contract for the construction of a 4-story, 60 x 150-ft. building, to Wells & Gray, Confederation Life Bldg., Toronto. Estimated cost, $90,000.

Industrial Notes

THE FOUNDATION OVEN CORPORATION is a new concern specializing in the "American" coke-oven, lignite-oven, carbonization process, recovery system, and coal products refining system. Its literature announces a complete chemical engineering service from test tube to finished plant. This is made possible through the association of the Foundation Oven Corp. with the Foundation Co. and the Foundation Research Laboratories, Inc. F. E. Breithut, lately major in the Chemical Warfare Service, is associated with the Foundation Oven Corp., with headquarters in the Woolworth Bldg., New York City.

THE METALS PRODUCTION CO., Chicopee, Mass., will pay creditors a first dividend of 10 per cent on all claims which have been approved and allowed and are not entitled to priority. The trustee has been ordered to pay in full all claims which have been approved and allowed and are entitled to priority. The dividend is payable immediately by Trustee Harry C. Dodge, Boston, Mass.

THE GARRED-CAVERS CORP. has made contracts and issued licenses for the use of the Garred-Cavers process at the smelters of the following companies: The International Nickel Co. of Canada, Ltd., the Tennessee Copper Co. and the Cerro de Pasco Copper Corp.

THE DRIVER-HARRIS CO., Harrison, N. J., is now selling its wire rope products direct to the trade instead of through its former selling agents. These products include sash cord and tiller rope in plain iron, galvanized iron, phosphor bronze, special bronze, monel metal, and all special grades. In addition to this, the company has increased its facilities to include all grades of rope in 6 x 7, 6 x 12, and 6 x 19 construction, such as drilling cable, elevator rope, haulage rope, sand lines, etc., in all sizes up to ¾ in. The other products of the company are resistance materials of nickel alloys in the form of wire, strip and sheet for electric heating controllers, rheostats and resistance elements, wire for spark plugs and weaving, rods and sheets of pure nickel and its alloys; cold rolled strip steel; nichrome castings such as annealing boxes, carbonizing boxes, pots, tubes, rotary and stationary retorts, dipping baskets, pyrometer protection tubes, etc.; flexible heater cord and thermostrip.

THE ELECTRIC FURNACE CO., Alliance, Ohio, recently shipped to the Dayton Engineering Laboratories, Dayton, Ohio, an electric furnace for melting and refining aluminum in the Delco plant. This furnace has a hearth capacity of 500 lb. and a melting rate of 200 lb. of aluminum per hr. It is equipped with a double charging door in the front and rear, and otherwise is similar to the standard Baily electric furnace of 105-kw. electrical capacity, and 1500-lb. hearth capacity, that is used for melting brass.

THE INGERSOLL-RAND CO., New York, N. Y., has established a branch office in the Sam Houston Life Bldg., Dallas, Texas, the better to serve the Texas and Oklahoma territory. The office will be in charge of Mr. R. H. Brown, Jr.

THE BOOTH ELECTRIC FURNACE CO. was organized in Chicago during the latter part of September with a paid-up capital of $1,000,000, one-half preferred stock and one-half common. This company was formed to take over all patents, assets and good will of the Booth-Hall Co., manufacturer of electric steel and brass melting furnaces. The new company has also taken over the business of the former company and proposes to develop the electric furnace business along standard manufacturing lines. It is now prepared to deliver furnaces in four sizes, 250-lb., 500-lb., 1000-lb. and 2000-lb. equipments. The two-phase two-electrode Booth-Hall furnace will be made in five sizes, i.e., ¾-ton, 1½-ton, 3-ton, 6-ton and 12-ton, and an improved type of oval furnace is also being designed. Associated in the management of the company will be a number of engineering and operating executives in the public service field. Mr. L. E. Myers, of Chicago, president of the L. E. Myers Co., has been elected president of the new corporation; Mr. C. H. Booth, formerly president of the Booth-Hall Co., vice-president; Mr. W. K. Booth, formerly chief engineer of the Booth-Hall Co., secretary; and Mr. L. J. Clark, of the L. E. Myers Co., treasurer. In addition to the president, vice-president and secretary, the board of directors will include Mr. Martin J. Insull, vice-president of the Middle West Utilities Co., and Mr. E. W. Lloyd, of the Commonwealth Edison Co., both of Chicago.

THE CARBORUNDUM COMPANY announces the opening of branch offices and warehouse in Detroit, Mich., in the Burkhardt Bldg., at Second and Larned Sts., under the direction of Mr. Anthony Dobson, who will have charge of the Detroit sales district. The new offices and the warehouse are opened with a view to giving quicker and better service to the users of carborundum products in the Detroit district, and to that end a complete stock of carborundum and aloxite grinding wheels, carborundum and aloxite paper and cloth and other carborundum products will be carried.

THE ST. LOUIS COKE & CHEMICAL CO. has disposed of $5,000,000 of 8 per cent cumulative preferred stock to the Studebaker Bros. Trust Co. of Chicago and the Mississippi Valley Trust Co. of St. Louis. The proceeds of the sale will be used for the construction of a new coke-oven and blast-furnace plant now being erected at Granite City, Ill. The entire output of hot metal, gas and tar has been contracted for a period of years to the National Enameling & Stamping Co.

HUNTINGTON, HEBERLEIN & CO., LTD., announces that the entire capital stock of the corporation has been acquired by Messrs. Henry Gardner & Co., Ltd., and that the business offices of the former will be transferred to the registered offices of the latter at 2, Metal Exchange Buildings, London, E. C. 3. The board of Huntington, Heberlein & Co., Ltd., will consist of Walter Gardner, chairman and managing director; H. C. Bingham, H. J. Bush and R. H. Bingham.

THE ARMSTRONG BUREAU OF RELATED INDUSTRIES, 11 South LaSalle St., Chicago, is a new institution, the first of its kind, founded on the principles that American business can reach its highest development and perform its greatest service to the commonwealth only through modern, co-operative methods. It renders a professional service by which competitive businesses attain maximum results through co-operation in organization, marketing and production. Mr. John Walsh, acting and chief counsel for the Federal Trade

Commission from its inception to April, 1919, has identified himself with this organization and will furnish his exclusive services to it on all matters pertaining to business and industrial co-operation. Mr. Walsh maintains headquarters in Washington, D. C.

M. Ferraris & Co., agents of the American Steel Export Co. for Italy, state that the continued activity and development of Italy as a field for American machinery, equipment, steel and metal products have caused them to send Mr. Joel B. Ives of the engineering and contracting department of the Export Company to Italy to confer with the Italian agents as to means of dealing adequately with the situation and insuring the continuance of effective sales service in that territory.

The Standard Chemical Co. of Toronto, the stock of which is largely held in England, has elected to the presidency David Gilmour, an eminent Scottish engineer of wide experience.

The Electric Furnace Construction Co., Philadelphia, Pa., advises orders received for Greaves-Etchells electric furnaces from Lacheze et Fils, Dijon; and C. Markham & Co., Ltd., Chesterfield.

The Westinghouse Electric & Mfg. Co. has announced the award of its four annual War Memorial Scholarships of $500 each. The following are the men who received the awards, the courses chosen and the schools at which their studies will be conducted: Herbert S. Pahren, Cincinnati, Ohio, technical engineering course at the Univ. of Wisconsin; Arthur Martens of East Pittsburgh, Pa., electrical engineering at the Carnegie Institute of Technology; Paul O. Langguth, East Pittsburgh, electrical engineering at the University of Pittsburgh; Andrew P. Lesniak, East Pittsburgh, mechanical engineering at the University of Pittsburgh. Each scholarship carries with it an annual payment of $500 for a period not to exceed four years, the payment to be applied toward an engineering education in any technical school of college selected by the successful candidate with the approval of the scholarship committee. These scholarships have been established as a memorial to those employees of the company and its subsidiaries who entered the service of their country during the war. Four awards will be made each year, so that after three years this company will be maintaining sixteen of these scholarships in the best technical schools of the United States.

The Chicago Pneumatic Tool Co. announces that on Oct. 1 its Birmingham office was removed from 801 Brown Marx Bldg., to 1925 Fifth Ave. North, where a service station with a complete stock of pneumatic tools, electric tools, air compressors, oil engines, rock drills and repair parts is maintained. This company also announces that Mr. C. W. Cross has been appointed manager of Western railroad sales with headquarters at the Fisher Bldg., Chicago.

Manufacturers' Catalogs

The Schutte & Koerting Co., Philadelphia, desires to announce that it has issued a revised 8-B catalog on Stop, Stop Check and Emergency Valves, and will be pleased to forward a copy to those interested and inquiring for same.

The Goulds Mfg. Co., Seneca Falls, N. Y., has published a bulletin entitled "Centrifugal Pump Sales Service Data." This was originally issued as a series of sales letters for its own organization, but owing to the demand from outside sources, the company decided to publish them in bulletin form and will be glad to send one on request. The bulletin contains information on theory, designs, testing, etc., of centrifugal pumps.

The Barber-Greene Co., Aurora, Ill., announces a new catalog showing the latest B-G standardized material handling machines, standardized belt conveyor (portable and stationary) and self-feeding bucket loaders. Copies will be sent upon request.

The Tolhurst Machine Works, Troy, N. Y.: Catalog 8 is a new and attractive catalog on its centrifugals (hydro-extractors), which are illustrated and described.

The Guyton & Cumfer Mfg. Co., Chicago, Ill., calls attention to Bull. No. 191 on steam jacketed pumps and steam jacketed pipe fittings.

The Cleveland Instrument Co., Cleveland, Ohio: "Cleveland Resistance Pyrometers" is the title of Bull. No. 40, just issued.

The Koppers Company, Pittsburgh, Pa., has issued attractive 68-page catalog illustrating and describing by-product coke and gas plants, benzol recovery plants, motor fuel recovery plants, tar distilling plants and ammonia recovery apparatus.

The Quigley Furnace Specialties Co., New York City: "Carbosand" is the title of a new booklet, just issued, describing a refractory granular material for making rammed-in linings, special tile patches and repairs in furnace structures. Another bulletin is "Hytempite in the Foundry," which describes the use of this high temperature cement in the various phases of foundry practice, taking up in sequence its applications in the iron foundry, steel foundry, brass foundry and malleable foundry.

The Lea-Courtenay Co., Newark, N. J., has recently issued two new bulletins: One, termed H-4, is a veritable treatise on centrifugal pumps as well as a catalog of its most complete line; the other, Bull. S-5, gives a synopsis of typical centrifugal pumps installed in various industries, showing the range of pumping service which its centrifugal pumps cover. Copies will be sent upon application.

The Milliken Bros. Mfg. Co., Inc., New York City, is distributing catalogs Nos. 10 and 11, descriptive of Milliken buildings. "Choice of a Thousand Buildings" is the title of Catalog No. 10, which illustrates and describes its buildings constructed by the standardized truss unit system, designed to facilitate transportation by rail or water or on animal back; to minimize the use of labor and tools in erection; and to meet a wide range of industrial service. Catalog No. 11, entitled "Erection Handbook," is a supplement to Catalog No. 10, and illustrates and describes in a comprehensive way all construction details necessary to make the proper foundations, and to erect any type of building selected, so that construction can be started just as soon as the material is received.

The New Jersey Zinc Co., New York: Five new booklets have been issued by this company, entitled "Chemicals," "Roller Zinc," "Zinc Dust," "Pigments" and "Metals."

The Metal & Thermit Corp., New York City, has issued a folder entitled "How Thermit Cured My Diseased Neck," which illustrates a thermit welding repair, consisting of building up with thermit steel the worn pods on the end of a 16-in. dia. neck of a large roughing mill pinion.

The W. S. Rockwell Co., New York, will gladly send to anyone interested its new steel heat-treatment chart.

The Bailey Meter Co. is distributing Bull. No. 30, entitled "Fluid Meters for Low-Pressure Gas and Air."

The Electric Furnace Co., Alliance, Ohio, calls attention to three new booklets just received from the printer. Booklet 7-B deals with electric furnaces for melting brass; Booklet 17-B describes a special furnace for rolling mills which is designed for pouring the metal directly into the molds; Booklet 13-B is a discussion of the various electric non-ferrous metal melting furnaces, which is a reprint of the paper delivered by T. F. Baily before the American Institute of Chemical Engineering, Boston, Mass., at the June, 1919, meeting.

Sarco Company, Inc., New York City: "Steam Trap Sarco" is the title of a new four-page booklet just issued.

The Star Brass Works, Chicago, Ill., has just issued a 24-page bulletin, No. 5, covering atomizing and spray nozzles for special applications. This literature deals with the application of spray nozzles for all industrial purposes, also engineering data involved in same. Copies will be sent upon request.

The Combustion Engineering Corporation, New York City, calls attention to its latest catalog on Grive Grates, which illustrates and describes the detail and operation of the grate. This attractive catalog will be sent upon request to anyone interested in burning a wide range of fuels under hand-fired conditions, with a high degree of economy.

The Bicycle Manufacturers' Association, Hartford, Conn., has published a booklet entitled "Industrial Transportation." This booklet calls attention to industrial concerns as to the advantage of a bicycle as a method of transportation for its employees.

The Petroleum Iron Works Co., Sharon, Pa., has issued a catalog of steel barrels and drums. This attractive catalog illustrates and describes in 28 pages the economic value of steel shipping containers, the "G-E-M" bilged steel barrels, the barrel with the hoop formation; "Presteel" I. C. C. drums; "Presteel" light gage shipping drums, and "P. I. W." storage tanks, together with authoritative information relative to its manufacture, advantages, use and general specifications.

The Wellman-Seaver-Morgan Co. desires to announce Bull. No. 27, which describes the automatic ore unloaders on the Great Lakes. Copies will be sent upon request.

The Foxboro Co., Inc., Foxboro, Mass.: Bull. No. 194-1, entitled "Foxboro Thermometers," is a complete treatise on the subject of temperature measuring instruments, which states that any temperature between the ranges of minus 60 to 1000 deg. F. can be measured accurately by these instruments. Special attention is called to pages 62 to 68, which show indicating thermometers with an improved style of dial, laid out from a scientific viewpoint to obtain the maximum visibility, and can be read without difficulty as far as 15 to 20 ft. Copies will gladly be sent upon request.

The Telzit Slide Rule Co., Chicago, Ill., has issued a booklet on the "Telzit" slide rule for instantly determining in advance the exact dimensions of coming cuts or for use in drawing or layout enlargement.

Bowser & Co., Fort Wayne, Ind., has issued a little folder which illustrates and describes a Bowser battery storage system for lubricating oil. The folder can be arranged to show one outfit, two outfits, three outfits or a battery of four tanks so that the prospect may understand that he can buy as many units as he requires, and the folder shows him how the units of any various capacities line up in uniform manner.

The Oliver Continuous Filter Co., San Francisco, Calif., has issued Bull. No. 12 on the construction, use and operation of the Oliver continuous filter and accessories. Illustrations showing apparatus under construction, in transit, and in actual plant operation are included, with information on the various sizes manufactured, the diversified products handled on the Oliver, and approximate capacities based on plant operations. The operation of the Oliver is fully covered, and the various adaptations of filter cloth, washing arrangements, etc., are completely explained. The Oliver sand table filter, for handling coarse and fast-settling materials, is also described and illustrated. Copies may be obtained upon application.

The Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.: Circular 1563, "Railway Converter Substations," is a compilation of ideas of operating engineers' experience in substation work, and data in connection with the Westinghouse standards and practices adopted after years of experience.

The American Ore Reclamation Co., New York City, has issued a booklet on "Sintering and Desulphurizing of Iron Ore Materials."

The Blaw-Knox Co., Pittsburgh, Pa.: Bull. No. 202, covering Knox water-cooled appliances for glass furnaces; Bull. 200, entitled "Blaw Cableways"; Bull. No. 293, Blawforms for light walls and foundations; "The Blaw System for Building Construction" is the title of Catalog No. 18. Any or all of these publications will be sent upon request.

The Cutler-Hammer Mfg. Co., Milwaukee, Wis.: C-H space heaters are illustrated and described in a new 4-page pamphlet, No. 479, entitled "Miscellaneous Applications of Electrical Heat"; C-H Rectangular Magnets" is the title of Booklet J, which illustrates and describes various types of apparatus; "C-H Drum Controllers" is the title of a new 4-page folder on this subject; C-H mine duty apparatus is illustrated and described in a new 8-page booklet which makes special reference to the mine duty apparatus installed in the plant of the St. Louis Smelting & Refining Co., St. Francois, Mo.

The Allis-Chalmers Mfg. Co., Milwaukee, Wis.: A booklet entitled "Prospectus of Apprenticeship System," which is for a young boy who shows talent along mechanical lines, offers an opportunity for him to become a first-class mechanic; Bull. No. 1432-C, on "Stamp Mills"; Bull. 1433, on "Allis-Chalmers Prospecting Mill for Free Gold Ores"; Bull. 1456, "Fairmont Type Crusher"; Bull. 1537, "Details of Allis-Chalmers Oil Engines," Diesel-type for ordering repairs and spare parts; "Centrifugal Pumps and Centrifugal Pumping Units" is the title of Bull. 1632-C, which illustrates large- and small-size centrifugal pumping units.